

JAPANESE [JP,2002-232448,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE
INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

* NOTICES *

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] In the network system equipped with two or more network connection equipments which make redundancy connection of a backbone network, the subnet which holds two or more terminal units, and a backbone network and a subnet Said each network connection equipment supervises switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network. With a house keeping means to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A contact information-interchange means to exchange the collected contact information for other network connection equipments connected to the same subnet using a backbone network, A subnet selection means to choose a subnet based on the equipment initial entry received from other network connection equipments, An ARP reply packet generation / transmitting means to transmit to the subnet which the ARP reply packet was generated [subnet] based on said contact information, and had the ARP reply packet concerned chosen, A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, An IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network when each IP addresses differ, A preparation and said each terminal unit are a network system which updates an ARP table based on the received ARP reply packet, and is characterized by the divided terminal unit communicating through a backbone network henceforth.

[Claim 2] Furthermore, an ARP packet receiving means to receive an ARP request packet or an ARP reply packet from a subnet, and to extract a target protocol address from the packet concerned, The 1st retrieval means which searches whether the information applicable to the target protocol address concerned was included in said collected contact information when said ARP packet receiving means received an ARP request packet, A request transfer means to transmit said ARP request packet to a backbone network when said information is not included, A reply transfer means to transmit the ARP reply packet concerned to a backbone network when said ARP packet receiving means receives an ARP reply packet, A backbone packet receiving means to receive an ARP request packet or an ARP reply packet from a backbone network, A subnet selection means to choose the subnet in which the target protocol address concerned is contained from the single which extracts and holds a target protocol address from the ARP packet which received, or two or more subnets, The request packet conversion means which rewrites the transmitting agency MAC Address and source hardware address of the packet concerned to a virtual MAC Address when said backbone packet receiving means receives an ARP request packet, A request packet transmitting means to transmit to the subnet which had the ARP request packet after rewriting chosen, The 2nd retrieval means which searches a MAC Address based on the target protocol address which said subnet selection means extracted when said backbone packet receiving means receives an ARP reply packet, The reply packet conversion means which rewrites a destination MAC Address and a target hardware

address to the MAC Address which it is as a result of retrieval, and rewrites a source hardware address to a virtual MAC Address, The network system according to claim 1 characterized by having a reply packet transmitting means to transmit to the subnet which had the ARP reply packet after rewriting chosen.

[Claim 3] In the network system equipped with two or more network connection equipments which make redundancy connection of a backbone network, the subnet which holds two or more terminal units, and a backbone network and a subnet Said each network connection equipment supervises switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network. With a house keeping means to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A packet generation means to generate an ARP reply packet based on the collected contact information, The packet operator stage which exchanges the generated ARP reply packet for other network connection equipments connected to the same subnet using a backbone network, A subnet selection means to choose a subnet based on the ARP reply packet received from other network connection equipments, An ARP reply packet transmitting means to transmit to the subnet which had said ARP reply packet chosen, A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, An IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network when each IP addresses differ, A preparation and said each terminal unit are a network system which updates an ARP table based on the received ARP reply packet, and is characterized by the divided terminal unit communicating through a backbone network henceforth.

[Claim 4] Furthermore, a recovery packet generation means to generate the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered, A preparation and said ARP reply packet transmitting means The ARP reply packet generated by said recovery packet generation means, And the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned which received from the backbone network, Transmit to a subnet and said each terminal unit returns an ARP table based on the received ARP reply packet. Henceforth, the network system according to claim 3 characterized by communicating by specifying each other MAC Address directly between the terminal units on the same subnet.

[Claim 5] Furthermore, the 1st recovery packet generation means which generates the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered, When the contact information for returning the ARP table of the terminal unit connected to the subnet concerned is received from a backbone network It has the 2nd recovery packet generation means which generates an ARP reply packet based on the contact information concerned. Said ARP reply packet generation / transmitting means The ARP reply packet generated by said 1st recovery packet generation means, The ARP reply packet generated by the 2nd recovery packet generation means is transmitted to a subnet. And said each terminal unit The network system according to claim 1 characterized by returning an ARP table based on the received ARP reply packet, and communicating by specifying each other MAC Address directly between the terminal units on the same subnet henceforth.

[Claim 6] Said contact information gathering means is the network system of any one publication of claim 1-5 characterized by having a request transmitting means to transmit an ICMP echo request message by the broadcast address, a receiving means to receive an ICMP echo reply message as a response to said request, and a study means to learn the combination of the IP address of the terminal unit in a subnet, and a MAC Address based on said ICMP echo reply message.

[Claim 7] If it is in each network connection equipment which makes redundancy connection of a backbone network and the subnet which holds two or more terminal units Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means to direct collection of contact

information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A contact information-interchange means to exchange the collected contact information for other network connection equipments connected to the same subnet using a backbone network, A subnet selection means to choose a subnet based on the equipment initial entry received from other network connection equipments, An ARP reply packet generation / transmitting means to transmit to the subnet which the ARP reply packet was generated [subnet] based on said contact information, and had the ARP reply packet concerned chosen, A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, Network connection equipment characterized by having an IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network when each IP addresses differ.

[Claim 8] Furthermore, an ARP packet receiving means to receive an ARP request packet or an ARP reply packet from a subnet, and to extract a target protocol address from the packet concerned, The 1st retrieval means which searches whether the information applicable to the target protocol address concerned was included in said collected contact information when said ARP packet receiving means received an ARP request packet, A request transfer means to transmit said ARP request packet to a backbone network when said information is not included, A reply transfer means to transmit the ARP reply packet concerned to a backbone network when said ARP packet receiving means receives an ARP reply packet, A backbone packet receiving means to receive an ARP request packet or an ARP reply packet from a backbone network, A subnet selection means to choose the subnet in which the target protocol address concerned is contained from the single which extracts and holds a target protocol address from the ARP packet which received, or two or more subnets, The request packet conversion means which rewrites the transmitting agency MAC Address and source hardware address of the packet concerned to a virtual MAC Address when said backbone packet receiving means receives an ARP request packet, A request packet transmitting means to transmit to the subnet which had the ARP request packet after rewriting chosen, The 2nd retrieval means which searches a MAC Address based on the target protocol address which said subnet selection means extracted when said backbone packet receiving means receives an ARP reply packet, The reply packet conversion means which rewrites a destination MAC Address and a target hardware address to the MAC Address which it is as a result of retrieval, and rewrites a source hardware address to a virtual MAC Address, Network connection equipment according to claim 7 characterized by having a reply packet transmitting means to transmit to the subnet which had the ARP reply packet after rewriting chosen.

[Claim 9] If it is in each network connection equipment which makes redundancy connection of a backbone network and the subnet which holds two or more terminal units Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A packet generation means to generate an ARP reply packet based on the collected contact information, The packet operator stage which exchanges the generated ARP reply packet for other network connection equipments connected to the same subnet using a backbone network, A subnet selection means to choose a subnet based on the ARP reply packet received from other network connection equipments, An ARP reply packet transmitting means to transmit to the subnet which had said ARP reply packet chosen, A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, Network connection equipment characterized by having an IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network when each IP addresses differ.

[Claim 10] Furthermore, a recovery packet generation means to generate the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered, A preparation and said ARP reply packet transmitting means The ARP reply packet generated by said recovery packet generation means, And network connection equipment according to claim 9 characterized by transmitting to a subnet the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned which received from the backbone network.

[Claim 11] Furthermore, the 1st recovery packet generation means which generates the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered, When the contact information for returning the ARP table of the terminal unit connected to the subnet concerned is received from a backbone network It has the 2nd recovery packet generation means which generates an ARP reply packet based on the contact information concerned. Said ARP reply packet generation / transmitting means Network connection equipment according to claim 7 characterized by transmitting to a subnet the ARP reply packet generated by said 1st recovery packet generation means, and the ARP reply packet generated by the 2nd recovery packet generation means.

[Claim 12] Said contact information-gathering means is network connection equipment of any one publication of claim 7-11 characterized by to have a request transmitting means to transmit an ICMP echo request message by the broadcast address, a receiving means to receive an ICMP echo reply message as a response to said request, and a study means to learn the combination of the IP address of the terminal unit in a subnet, and a MAC Address based on said ICMP echo reply message.

[Translation done.]

* NOTICES *

JPO and NCIP are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the network system and network connection equipment between the terminals at the time of subnet fragmentation which can relieve a communication link especially about the network system equipped with two or more network connection equipments which make redundancy connection of a backbone network and the subnet.

[0002]

[Description of the Prior Art] Hereafter, the conventional technique is explained. In IP (Internet Protocol) network, other networks and the divided subnet communicate with the exterior of the subnet concerned via a router with a router. However, since it becomes impossible to communicate with the exterior of a subnet when a router breaks down, generally performing redundancy-ization of a communication path using two or more routers is known.

[0003] As a system which performs redundancy-ization of a communication path using two or more routers, "the router network which has Subordinate's LAN relief function in a router failure" of a publication is in JP,11-261620,A, for example. Drawing 28 R> 8 is drawing showing the conventional structure of a system. drawing 28 -- setting -- 10 -- present -- business -- it is a router, 11 is a substitute router, 12 is other routers, 13 is an ATM network, and 14 is the subnet by which the router was redundancy-ized.

[0004] a technique given [above-mentioned] in an official report -- a subnet 14 -- one -- present -- business -- a router 10 -- present -- business -- substitute router 11 with an another router 10 is prepared. this time -- present -- business -- the network environment of a router 10 -- the substitute router 11 -- beforehand -- setting up -- the substitute router 11 -- a ping packet etc. -- present -- business -- a router 10 is supervised. and -- present -- business -- the case where a router 10 becomes a failure -- present -- business -- the MAC (Media Access Control) address which was being used with the router 10 -- the substitute router 11 -- succeeding -- the substitute router 11 -- present -- business -- it takes the place and operates to a router 10. if it says concretely -- present -- business -- the case where a router 10 becomes a failure -- the substitute router 11 -- present -- business -- the physical address currently used with the router 10 is succeeded, and junction of the communication link frame to the outside of a subnet is executed by proxy. Thereby, the connectability of a subnet 14 and other subnets is securable.

[0005] Moreover, as a system which performs redundancy-ization of a communication path using two or more routers, there is a network system which used VRRP (Virtual Router Redundancy Protocol, Internet Engineering Task Force:IETF RFC2338) in addition to the above.

[0006] Two or more routers constitute a virtual router, and VRRP shares a virtual MAC Address and a common IP address. present -- business -- a router transmits a VRRP message into a subnet periodically -- a virtual MAC Address and an IP address -- a standby router -- notifying -- present -- business -- **** of a router is made to know on the other hand -- a standby router -- fixed time amount -- present -- business -- there is no arrival of the VRRP message from a router -- having -- present -- business -- the failure of a router is detected and

substitute actuation is performed using a virtual MAC Address and an IP address.

[0007] Drawing 29 is drawing showing the configuration of the network system which used VRRP. In drawing 29 , 20 and 21 are routers, 23, 24, and 25 are switching hubs, 26 and 27 are terminal units, 28 is a subnet, and 29 is a backbone network.

[0008] Moreover, drawing 30 is drawing showing the outline of an ARP (Address Resolution Protocol) reply packet format in which it is used by VRRP. In drawing 30 , 30a is a destination MAC Address (MAC_DA), 30b is a transmitting agency MAC Address (MAC_SA), 30c is a source hardware address (solvent refined coal_MAC_ADDR), 30d is a source protocol address (solvent refined coal_IP_ADDR), 30e is a target hardware address (TAGT_MAC_ADDR), and 30f is a target protocol address (TAGT_IP_ADDR).

[0009] In terminal units 26 and 27, if the virtual MAC Address is set up as a default route, the communication link frame to the outside of a subnet will be transmitted to a virtual MAC Address. for example, the router 20 — present — business — as a router, when the router 21 is operating as a standby router, a router 20 relays a communication link frame.

[0010] and — present — business — failure of a router 20 transmits the ARP reply packet shown in drawing 30 to a subnet 28 in the standby router 21. That is, in the standby router 21, a virtual MAC Address is stored in transmitting agency MAC Address 30b and source hardware address 30c, a share IP address is stored in source protocol address 30d, a broadcast address is stored in destination MAC Address 30a, and an ARP reply packet is transmitted to a subnet 28 in this condition.

[0011] Moreover, in each switching hub, the above-mentioned ARP reply packet is received and transmitted, it learns that the equipment of a virtual MAC Address is in the port of the direction of a router 21, and the MAC frame addressed to a virtual MAC Address is henceforth transmitted in the direction of a router 21. thereby — present — business — when a router 20 breaks down, the connectability of a subnet 27 and other subnets can be secured.

[0012]

[Problem(s) to be Solved by the Invention] However, in the above and the system by which redundancy connection of two or more routers was made, when a subnet was divided, in spite of having connected physically each terminal unit linked to a separate segment via other networks, there was a problem of it becoming impossible to perform a mutual communication link.

[0013] For example, in drawing 29 , when a switching hub 24 breaks down, the ARP request packet from a terminal unit 26 to a terminal unit 27 cannot communicate by flowing becoming impossible. Moreover, although a terminal unit 26 sets the MAC Address of a terminal unit 27 as a destination MAC Address and transmits the packet to a terminal unit 27 about the case where the entry of a terminal unit 27 is stored in the ARP table of a terminal unit 26, the junction of the packet concerned will become impossible by failure of a switching hub 24, and a communication link will stop.

[0014] This invention is made in view of the above, and in the system by which redundancy connection of a subnet and other networks was made, when each terminal is divided by failure within a subnet, it aims at obtaining the network connection equipment which can continue the communication link between terminals.

[0015]

[Means for Solving the Problem] If it is in the network system concerning this invention in order to solve the technical problem mentioned above and to attain the purpose A backbone network and the subnet which holds two or more terminal units, It has two or more network connection equipments which make redundancy connection of a backbone network and the subnet. Said each network connection equipment Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means (equivalent to the condition check section 101 of the gestalt of operation mentioned later) to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information (equivalent to the contact information gathering section 102), A contact information-interchange means to

exchange the collected contact information for other network connection equipments connected to the same subnet using a backbone network (equivalent to the contact information-interchange section 103), A subnet selection means to choose a subnet based on the equipment initial entry received from other network connection equipments (equivalent to the subnet selection section 174), An ARP reply packet generation / transmitting means to transmit to the subnet which the ARP reply packet was generated [subnet] based on said contact information, and had the ARP reply packet concerned chosen (equivalent to the packet generation section 173 and the packet transmitting section 104), A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit (equivalent to a comparator 106), An IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network when each IP addresses differ (equivalent to the junction section 105), A preparation and said each terminal unit update an ARP table based on the received ARP reply packet, and are henceforth characterized by communicating with the divided terminal unit through a backbone network.

[0016] If it is in the network system concerning the next invention Furthermore, an ARP packet receiving means to receive an ARP request packet or an ARP reply packet from a subnet, and to extract a target protocol address from the packet concerned (equivalent to the ARP packet receive section 518), When said ARP packet receiving means receives an ARP request packet The 1st retrieval means which searches whether the information applicable to the target protocol address concerned was included in said collected contact information (equivalent to the Banking Inspection Department 519), A request transfer means to transmit said ARP request packet to a backbone network when said information is not included (equivalent to the request transfer section 520), A reply transfer means to transmit the ARP reply packet concerned to a backbone network when said ARP packet receiving means receives an ARP reply packet (equivalent to the reply transfer section 527), A backbone packet receiving means to receive an ARP request packet or an ARP reply packet from a backbone network (equivalent to the backbone packet receive section 521), A target protocol address is extracted from the ARP packet which received. A subnet selection means to choose the subnet in which the target protocol address concerned is contained from the single to hold or two or more subnets (equivalent to the subnet selection section 524), When said backbone packet receiving means receives an ARP request packet The request packet conversion means which rewrites the transmitting agency MAC Address and source hardware address of the packet concerned to a virtual MAC Address (equivalent to the request packet transducer 525), A request packet transmitting means to transmit to the subnet which had the ARP request packet after rewriting chosen (equivalent to the request packet transmitting section 526), When said backbone packet receiving means receives an ARP reply packet The 2nd retrieval means which searches a MAC Address based on the target protocol address which said subnet selection means extracted (equivalent to the retrieval section 519), A destination MAC Address and a target hardware address are rewritten to the MAC Address which it is as a result of retrieval. The reply packet conversion means which rewrites a source hardware address to a virtual MAC Address (equivalent to the reply packet transducer 522), It is characterized by having a reply packet transmitting means (equivalent to the reply packet transmitting section 523) to transmit to the subnet which had the ARP reply packet after rewriting chosen.

[0017] If it is in the network system concerning the next invention A backbone network and the subnet which holds two or more terminal units, It has two or more network connection equipments which make redundancy connection of a backbone network and the subnet. Said each network connection equipment Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means (equivalent to condition check section 101a) to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A packet generation means to generate an ARP reply packet based on the collected contact information (equivalent to transfer packet generation section 175a), The

packet operator stage which exchanges the generated ARP reply packet for other network connection equipments connected to the same subnet using a backbone network (equivalent to contact information-interchange section 103a), A subnet selection means to choose a subnet based on the ARP reply packet received from other network connection equipments (equivalent to subnet selection section 174a), An ARP reply packet transmitting means to transmit to the subnet which had said ARP reply packet chosen (equivalent to the packet transmitting section 104), A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, An IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network when each IP addresses differ, A preparation and said each terminal unit update an ARP table based on the received ARP reply packet, and are henceforth characterized by communicating with the divided terminal unit through a backbone network.

[0018] If it is in the network system concerning the next invention Furthermore, a recovery packet generation means to generate the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered (equivalent to recovery packet generation section 641c), A preparation and said ARP reply packet transmitting means The ARP reply packet generated by said recovery packet generation means, And the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned which received from the backbone network, It is characterized by for said each terminal unit returning an ARP table based on the received ARP reply packet, and communicating by transmitting to a subnet and specifying each other MAC Address directly between the terminal units on the same subnet henceforth.

[0019] If it is in the network system concerning the next invention Furthermore, the 1st recovery packet generation means which generates the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered (equivalent to recovery packet generation section 641c), When the contact information for returning the ARP table of the terminal unit connected to the subnet concerned is received from a backbone network The 2nd recovery packet generation means which generates an ARP reply packet based on the contact information concerned (equivalent to 173d of packet generation sections), A preparation and said ARP reply packet generation / transmitting means The ARP reply packet generated by said 1st recovery packet generation means, The ARP reply packet generated by the 2nd recovery packet generation means is transmitted to a subnet. And said each terminal unit It is characterized by returning an ARP table based on the received ARP reply packet, and communicating by specifying each other MAC Address directly between the terminal units on the same subnet henceforth.

[0020] In the network system concerning the next invention said contact information gathering means A request transmitting means to transmit an ICMP echo request message by the broadcast address (equivalent to the request transmitting section 441), A receiving means to receive an ICMP echo reply message as a response to said request (equivalent to a receive section 442), It is characterized by having a study means (equivalent to the study section 443) to learn the combination of the IP address of the terminal unit in a subnet, and a MAC Address based on said ICMP echo reply message.

[0021] If it is in the network connection equipment concerning the next invention Redundancy connection of a backbone network and the subnet which holds two or more terminal units is made. For example Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A contact information-interchange means to exchange the collected contact information for other network connection equipments connected to the same subnet using a backbone network, A subnet selection means to choose a subnet based on the equipment initial entry received from other network connection equipments, An ARP reply packet generation / transmitting means to transmit to the subnet which the ARP

reply packet was generated [subnet] based on said contact information, and had the ARP reply packet concerned chosen, A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, When each IP addresses differ, it is characterized by having an IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network.

[0022] If it is in the network connection equipment concerning the next invention Furthermore, an ARP packet receiving means to receive an ARP request packet or an ARP reply packet from a subnet, and to extract a target protocol address from the packet concerned, The 1st retrieval means which searches whether the information applicable to the target protocol address concerned was included in said collected contact information when said ARP packet receiving means received an ARP request packet, A request transfer means to transmit said ARP request packet to a backbone network when said information is not included, A reply transfer means to transmit the ARP reply packet concerned to a backbone network when said ARP packet receiving means receives an ARP reply packet, A backbone packet receiving means to receive an ARP request packet or an ARP reply packet from a backbone network, A subnet selection means to choose the subnet in which the target protocol address concerned is contained from the single which extracts and holds a target protocol address from the ARP packet which received, or two or more subnets, The request packet conversion means which rewrites the transmitting agency MAC Address and source hardware address of the packet concerned to a virtual MAC Address when said backbone packet receiving means receives an ARP request packet, A request packet transmitting means to transmit to the subnet which had the ARP request packet after rewriting chosen, The 2nd retrieval means which searches a MAC Address based on the target protocol address which said subnet selection means extracted when said backbone packet receiving means receives an ARP reply packet, The reply packet conversion means which rewrites a destination MAC Address and a target hardware address to the MAC Address which it is as a result of retrieval, and rewrites a source hardware address to a virtual MAC Address, It is characterized by having a reply packet transmitting means to transmit to the subnet which had the ARP reply packet after rewriting chosen.

[0023] If it is in the network connection equipment concerning the next invention Redundancy connection of a backbone network and the subnet which holds two or more terminal units is made. For example Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A packet generation means to generate an ARP reply packet based on the collected contact information, The packet operator stage which exchanges the generated ARP reply packet for other network connection equipments connected to the same subnet using a backbone network, A subnet selection means to choose a subnet based on the ARP reply packet received from other network connection equipments, An ARP reply packet transmitting means to transmit to the subnet which had said ARP reply packet chosen, A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, When each IP addresses differ, it is characterized by having an IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network.

[0024] If it is in the network connection equipment concerning the next invention Furthermore, a recovery packet generation means to generate the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered, A preparation and said ARP reply packet transmitting means It is characterized by transmitting to a subnet the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned which received from the ARP reply packet generated by said recovery packet generation means, and the backbone network.

[0025] If it is in the network connection equipment concerning the next invention Furthermore, the 1st recovery packet generation means which generates the ARP reply packet for returning

the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered, When the contact information for returning the ARP table of the terminal unit connected to the subnet concerned is received from a backbone network It has the 2nd recovery packet generation means which generates an ARP reply packet based on the contact information concerned. Said ARP reply packet generation / transmitting means It is characterized by transmitting to a subnet the ARP reply packet generated by said 1st recovery packet generation means, and the ARP reply packet generated by the 2nd recovery packet generation means.

[0026] In the network connection equipment concerning the next invention, it carries out that said contact information gathering means is equipped with a request transmitting means to transmit an ICMP echo request message by the broadcast address, a receiving means to receive an ICMP echo reply message as a response to said request, and a study means learn the combination of the IP address of the terminal unit in a subnet, and a MAC Address based on said ICMP echo reply message as the description.

[0027]

[Embodiment of the Invention] Below, the gestalt of operation of the network system concerning this invention and network connection equipment is explained at a detail based on a drawing. In addition, this invention is not limited by the gestalt of this operation.

[0028] Gestalt 1. drawing 1 of operation is drawing showing the configuration of the gestalt 1 of operation of the network connection equipment concerning this invention. In drawing 1 , 100 is network connection equipment, and 101 is the condition check section. 102 is the contact information gathering section and 103 is the contact information-interchange section. 104 is the packet transmitting section, 105 is the junction section, and 106 is a comparator. 107 is the Records Department which records contact information, and 108 is an ARP table. 173 is the packet generation section and 174 is the subnet selection section. 210 is a backbone network, 211 is a communication path to which between network connection equipment is connected, 230 is a subnet, 291 is input/output port of a subnet, and 293 is input/output port of a backbone network.

[0029] Moreover, drawing 2 is drawing showing an example of a network system which used the network connection equipment of the gestalt 1 of operation. In drawing 2 , 200 is the above-mentioned network connection equipment 100 and network connection equipment with the same configuration, 231,232,233,234 is a switching hub, 221,222,227 is a terminal unit, 223 is the ARP table of a terminal unit 221, 224 is the ARP table of a terminal unit 222, 281,282,283 is input/output port of a switching hub 231, 284,285 is input/output port of a switching hub 232, and 286,287,288,289 is input/output port of a switching hub 233.

[0030] Here, actuation of the above-mentioned network connection equipment is explained using drawing 1 and drawing 2 . In addition, with the gestalt of this operation, the network connection equipments 100 and 200 take a redundant configuration, and connect a backbone network 210 and a subnet 230. moreover, network connection equipment 100 -- as a standby router -- network connection equipment 200 -- present -- business -- it shall operate as a router, respectively

[0031] First, with network connection equipment 100, the condition check section 101 supervises switch-on with network connection equipment 200 via a subnet 230. It is good also as performing this monitor using ping, and good also as carrying out by the monitor of a VRRP message etc. Moreover, in the condition check section 101 of network connection equipment 100, the operating state of self-equipment is periodically transmitted to the condition check section 101 of network connection equipment 200 using the communication path 211 on a backbone network 210. or [operating as a standby router with operating state here] -- or -- present -- business -- the information which shows whether it is operating as a router is meant.

[0032] In addition, when a backbone network 210 is an ATM (Asynchronous Transfer Mode) network, VC (virtual channel) is used as an example of a communication path 211.

[0033] In this condition, when a terminal unit 221 and a terminal unit 222 perform data communication, in each terminal unit, each other IP address recognized beforehand and the

mutual MAC Address learned by ARP are registered into an ARP table. In addition, drawing 3 is drawing showing an example of the entry (an IP address, MAC Address) recorded on the ARP table of a terminal unit 221 (in (a), (b) expresses the time of a failure for always [forward]), 481a is an IP address (IP_222), 481b is a MAC Address (MAC_222), 482a is an IP address (IP_222), and 482b is a MAC Address (MAC_100). Moreover, drawing 4 is drawing showing an example of the entry recorded on the ARP table of a terminal unit 222 (in (a), (b) expresses the time of a failure for always [forward]), 486a is an IP address (IP_221), 486b is a MAC Address (MAC_221), 487a is an IP address (IP_221), and 487b is a MAC Address (MAC_200).

[0034] In a switching hub 231, the ARP packet transmitted from a terminal unit 221 is received in a port 282, and it learns that the terminal unit 221 is connected to the point of a port 282 based on a transmitting agency MAC Address. Moreover, the ARP packet transmitted from a terminal unit 222 is received in a port 283, and it learns that the terminal unit 222 is connected to the point of a port 283 based on a transmitting agency MAC Address. It learns that similarly a terminal unit 221 is connected to the point of a port 284, and entering 222 is connected to the point of a port 285 in a switching hub 232, and learns that a terminal unit 221 is connected to the point of a port 286, and the terminal unit 222 is further connected to the point of a port 287 in a switching hub 233.

[0035] After learning as mentioned above, in a switching hub 231, the MAC frame addressed to the MAC Address of a terminal unit 221 is outputted from a port 282, and the MAC frame addressed to the MAC Address of a terminal unit 222 is outputted from a port 283. Drawing 5 is drawing showing the transmitting MAC frame from a terminal unit 221 to a terminal unit 222. In drawing 5, 300a is a MAC header unit, 300b is IP frame section, 301 is a destination MAC Address (MAC_222), 302 is a transmitting agency MAC Address (MAC_221), 303 is a destination IP address (IP_222), and 304 is a transmitting agency IP address (IP_221). Here, the IP address of a terminal unit 222 is set as destination IP address 303, the learned MAC Address is set as destination MAC Address 301, the IP address in the end of a local is set as transmitting agency IP address 304, the MAC Address in the end of a local is set as transmitting agency MAC Address 302, and the MAC frame is transmitted to a network after that.

[0036] And the above-mentioned MAC frame is notified to a terminal unit 222 via the ports 282 and 283 of a switching hub 231, the ports 284 and 285 of a switching hub 232, and the ports 286 and 287 of a switching hub 233 based on destination MAC Address 301.

[0037] On the other hand, when a switching hub 232 breaks down and it becomes impossible to perform junction actuation, in the condition check section 101 of network connection equipment 100, failure generating is recognized by failure of ping, un-arriving [of a VRRP message], etc., and collection of contact information is directed to the contact information gathering section 102. and the communication path 211 — going — network connection equipment 200 — receiving — self-equipment — henceforth — present — business — the purport which operates as a router is notified.

[0038] Drawing 6 is drawing showing the configuration of the contact information gathering section 102. In drawing 6, 441 is the request transmitting section which transmits an ICMP echo request message by broadcasting, 442 is a receive section which receives an ICMP echo reply message, and 443 is the study section which learns the combination of an IP address and a MAC Address. Here, actuation of the contact information gathering section 102 in network connection equipment 100 is explained. In addition, it operates similarly about the contact information gathering section 102 in network connection equipment 200.

[0039] Moreover, drawing 7 is drawing showing an example of a MAC frame format which stores the ICMP echo request message used for contact information gathering. In drawing 7, 451 is a MAC header unit, 452 is IP header unit, 453 is the ICMP message section, 454 is a destination MAC Address (MAC_Broadcast), 455 is a transmitting agency MAC Address (MAC_100), 456 is a destination IP address (IP_SubnetBroadcast), and 457 is a transmitting agency IP address (IP_100).

[0040] In the contact information gathering section 102 in network connection equipment 100, the ICMP echo request message generated because the request transmitting section 441 makes destination MAC Address 454 a broadcast address and makes destination IP address 456 the

broadcast address to a subnet 230 is transmitted to the port 291 of a subnet 230. This message is relayed by the switching hub 231, and is notified to a terminal unit 221.

[0041] In the terminal unit 221 which received the ICMP echo request message, an ICMP echo reply message is transmitted as a response. Drawing 8 is drawing showing an example of a MAC frame format which stores the ICMP echo reply message used for contact information gathering. In drawing 8, 461 is a MAC header unit, 462 is IP header unit, 463 is the ICMP message section, 464 is a destination MAC Address (MAC_100), 465 is a transmitting agency MAC Address (MAC_221), 466 is a destination IP address (IP_100), and 467 is a transmitting agency IP address (IP_221). Here, the ICMP echo reply message generated by setting the IP address in the end of a local as transmitting agency IP address 467, and setting the MAC Address of self-equipment as transmitting agency MAC Address 465 as a response to an ICMP echo request message is transmitted. It is received by the receive section 442 of network connection equipment 100, and this reply message is notified to the study section 443.

[0042] In the study section 443, the received reply message is scrutinized, the combination of transmitting agency IP address 467 and transmitting agency MAC Address 465 is learned, and it stores in the Records Department 107 and the ARP table 108 by making the study result into contact information.

[0043] With the network connection equipment 100 which collected contact information by the contact information gathering section 102 as mentioned above, the contact information-interchange section 103 transmits the collected IP addresses to the communication path 211 on a backbone network 210. This contact information is notified to the contact information-interchange section 103 of network connection equipment 200, and is further transmitted to the subnet selection section 174.

[0044] In the subnet selection section 174 of network connection equipment 200, based on the received contact information, the subnet 230 which holds the communication terminal 222 which may communicate with a terminal unit 221 is chosen, and the contact information concerned is further notified to the packet generation section 173.

[0045] In the packet generation section 173 of network connection equipment 200, based on the received contact information, an ARP reply packet is generated and the packet concerned is transmitted to a subnet 230. Drawing 9 (a) is drawing showing an example of an ARP reply packet format. In drawing 9 (a), 470a is a destination MAC Address (MAC_Broadcast), 470b is a transmitting agency MAC Address (MAC_200), 470c is a source hardware address (MAC_200), 470d is a source protocol address (IP_200), 470e is a target hardware address (MAC_200), and 470f is a target protocol address (IP_221). The IP address here included in the received contact information is set as target protocol address 470f. The IP address which self-network connection equipment 200 is using in the port 292 is set as source protocol address 470d. The MAC Address which self-network connection equipment 200 is using in the port 292 is set as source hardware address 470c, target hardware address 470e, and transmitting agency MAC Address 470b. A broadcast address is set as destination MAC Address 470a, and the packet transmitting section 104 transmits the generated ARP reply packet to a subnet 230. At this time, an ARP reply packet is notified to a terminal unit 222 via a switching hub 233.

[0046] In the terminal unit 222 which received the ARP reply packet, the ARP table 224 is updated based on target protocol address 470f and target hardware address 470e which are contained in the packet concerned. Speaking concretely, updating like the entry which shows the entry shown in drawing 4 (a) to (b), for example. In addition, the above renewal actuation of an ARP table of a terminal unit 222 is general actuation of ARP specified to IETF (Internet Engineering Task Force) and RFC826. Moreover, after the completion of updating actuation, with a terminal unit 222, when transmitting an IP packet to a terminal unit 221, MAC Address 487b is set as a destination MAC Address, by the switching hub 233, a port 288 will be relayed and the received IP packet concerned will be transmitted to network connection equipment 200.

[0047] moreover, with network connection equipment 200, it has been sent from the condition check section 101 of network connection equipment 100 -- " -- present -- business -- it recognizes that the failure generated notice" of a purport which operates as a router in the subnet 230 in what the condition check section 101 receives. And in the same procedure as the

above-mentioned network connection equipment 100, the contact information gathering section 102 of network connection equipment 200 collects the IP addresses of terminal units 222 and 227 as contact information, and the contact information-interchange section 103 transmits the contact information concerned to network connection equipment 100.

[0048] And with the network connection equipment 100 which received contact information, with the same procedure as the above-mentioned network connection equipment 200, the ARP reply packet shown in the ARP reply packet shown in drawing 9 (b) and (c) is generated / transmitted using the contact information-interchange section 103, the subnet selection section 174, the packet generation section 173, and the packet transmitting section 104, and the ARP table 223 of a terminal unit 221 is updated. Speaking concretely, updating like the entry which shows the entry shown in drawing 3 R> 3 (a) to (b), for example. In addition, in drawing 9 (b), 471a is a destination MAC Address (MAC_Broadcast). 471b is a transmitting agency MAC Address (MAC_100), and 471c is a source hardware address (MAC_100). 471d is a source protocol address (IP_100), and 471e is a target hardware address (MAC_100). 471f is a target protocol address (IP_222), and it sets to drawing 9 (c). 472a is a destination MAC Address (MAC_Broadcast). 472b is a transmitting agency MAC Address (MAC_100), and 472c is a source hardware address (MAC_100). 472d is a source protocol address (IP_100), 472e is a target hardware address (MAC_100), and 472f is a target protocol address (IP_227).

[0049] However, a terminal unit 221 and a terminal unit 227 do not communicate, and even when the ARP reply packet which a terminal unit 221 shows to drawing 9 (c) when there is no entry equivalent to a terminal unit 227 in the ARP table 223 of a terminal unit 221 is received, updating and an addition of the ARP table 223 are not performed.

[0050] Since MAC Address 482b is set to the destination MAC Address of the MAC frame next when a terminal unit 221 transmits an IP packet to a terminal unit 222, in a switching hub 231, a port 281 is relayed and the received MAC frame is transmitted to network connection equipment 100.

[0051] With the network connection equipment 100 which received the MAC frame, a comparator 106 compares the IP address currently used in the port 291, the destination IP address in the MAC frame concerned, and the MAC Address currently used in the port 291 and the destination MAC Address in the MAC frame concerned, respectively. And when a MAC Address is equal and IP addresses differ, the junction section 105 relays the IP packet section in the MAC frame to network connection equipment 200.

[0052] With the network connection equipment 200 which received the IP packet, the IP packet concerned is set as the MAC frame, further, the MAC Address which corresponds by searching an ARP table based on a destination IP address is gained, the retrieval result is set as the destination MAC Address of the MAC frame, and the MAC frame generated here is relayed to a port 292. At this time, the MAC frame is notified to a terminal unit 222 via a switching hub 233. In addition, also when a terminal unit 222 transmits an IP packet to a terminal unit 221, network connection equipment 200 and network connection equipment 100 are relayed to an IP packet by the same procedure as the above, and it is notified to a terminal unit 221.

[0053] However, the IP address which each network connection equipment uses, and a MAC Address are good also as using the address which is different with each equipment, and good also as using the common address with protocols, such as VRRP. moreover, the case where the common address is used — and — present — business — while the network connection equipment which operates as a router is healthy, the network connection equipment which operates as a standby router does not communicate using the address concerned.

[0054] Thus, even when each terminal unit in a subnet 230 is divided by failure etc., it can write as the configuration which communicates via a backbone network 210, and the communication link between the distributed terminal units can be made to continue in the gestalt of this operation. Moreover, when it is the same as that of the above, the ARP reply packet which the terminal unit connected to the subnet generated with the network connection equipment connected to self is written as the configuration which rewrites an ARP table in reception and general actuation of ARP, and a communication path can be changed, without adding special processing. Moreover, in the gestalt of this operation, an ICMP echo request message is

transmitted by the broadcast address at the time of contact information gathering, it writes as the configuration which collects to coincidence the ICMP echo reply messages from each terminal unit connected to the subnet, and contact information can be collected efficiently.

[0055] Gestalt 2. drawing 10 of operation is drawing showing the configuration of the gestalt 2 of operation of the network connection equipment concerning this invention. In drawing 10, 100a is network connection equipment, 101a is the condition check section, 103a is the contact information-interchange section, 174a is the subnet selection section, and 175a is the transfer packet generation section. Moreover, drawing 11 is drawing showing an example of a network system which used the network connection equipment of the gestalt 2 of operation. In drawing 11, 200a is network connection equipment with the same configuration as the above-mentioned network connection equipment 100a. In addition, about the same configuration as the gestalt 1 of the above-mentioned operation, the same sign is attached and the explanation is omitted.

[0056] Here, actuation of the above-mentioned network connection equipment is explained using drawing 10 and drawing 11. In addition, the gestalt of this operation explains only different actuation from the gestalt 1 of the above-mentioned operation. Moreover, the network connection equipments 100a and 200a take a redundant configuration, and the network system of the gestalt of this operation connects a backbone network 210 and a subnet 230. moreover, network connection equipment 100a — as a standby router — network connection equipment 200a — present — business — it shall operate as a router, respectively Moreover, each network connection equipment shall share the virtual MAC Address (henceforth referred to as MAC_V), and the IP address (it is henceforth called IP_V).

[0057] First, in network connection equipment 100a, condition check section 101a supervises switch-on with network connection equipment 200a via a subnet 230. this monitor — a VRRP message etc. — using — present — business — it carries out by receiving the periodical packet transmitted from a router. Moreover, in condition check section 101 of network connection equipment 100a, the operating state of self-equipment is periodically transmitted to condition check section 101 of network connection equipment 200a using the communication path 211 on a backbone network 210. or [operating as a standby router with operating state here] — or — present — business — the information which shows whether it is operating as a router is meant.

[0058] For example, when a switching hub 232 breaks down and it becomes impossible to perform junction actuation, in condition check section 101 of network connection equipment 100a, failure generating is recognized by un-arriving [of a VRRP message], and collection of contact information is directed to the contact information gathering section 102. and the communication path 211 — going — network connection equipment 200a — receiving — self-equipment — henceforth — present — business — the purport which operates as a router is notified.

[0059] In the contact information gathering section 102 (refer to drawing 6), with the same procedure as the case of the gestalt 1 of operation, the combination of a transmitting agency IP address and a transmitting agency MAC Address is learned, and it stores in the Records Department 107 and the ARP table 108 by making the result into contact information.

[0060] In network connection equipment 100a which collected contact information by the contact information gathering section 102 as mentioned above, transfer packet generation section 175a generates an ARP reply packet based on the contact information concerned. Drawing 12 (a) is drawing showing an example of an ARP reply packet format. In drawing 12 (a), 475a is a destination MAC Address (MAC_Broadcast), 475b is a transmitting agency MAC Address (MAC_V), 475c is a source hardware address (MAC_V), 475d is a source protocol address (IP_V), 475e is a target hardware address (MAC_V), and 475f is a target protocol address (IP_221). An ARP reply packet is generated by setting the IP address here included in the stored contact information as target protocol address 475f, setting MAC_V which is a virtual MAC Address, respectively as target hardware address 475e, source hardware address 475c, and transmitting agency MAC Address 475b, setting IP_V which is a share IP address as source protocol address 475d, and setting a broadcast address as destination MAC Address 475a.

[0061] And in contact information-interchange section 103a, contact information is transmitted

to the communication path 211 of a backbone network 210 in the form of the generated ARP reply packet. The contact information on this ARP reply packet format (it is only henceforth called an ARP reply packet) is notified to contact information-interchange section 103 of network connection equipment 200a, and is further transmitted to subnet selection section 174a.

[0062] The subnet 230 which holds the communication terminal 222 which may communicate with a terminal unit 221 based on the received ARP reply packet in subnet selection section 174 of network connection equipment 200a is chosen, and the ARP reply packet concerned is further transmitted to a subnet 230 in the packet transmitting section 104. At this time, an ARP reply packet is notified to a terminal unit 222 via a switching hub 233.

[0063] In the terminal unit 222 which received the ARP reply packet, the ARP table 224 is updated based on target protocol address 475f and target hardware address 475e which are contained in the packet concerned. Drawing 13 is drawing showing an example of the entry after updating (ARP table 224), 488a is an IP address (IP_221), and 488b is a MAC Address (MAC_V).

[0064] moreover, in network connection equipment 200a, it has been sent from condition check section 101 of network connection equipment 100a a — " — present — business — it recognizes that the failure generated notice" of a purport which operates as a router in the subnet 230 in what condition check section 101a receives. In the same procedure as the above-mentioned network connection equipment 100a, and the contact information gathering section 102 of network connection equipment 200a The IP addresses of terminal units 222 and 227 are collected as contact information. Transfer packet generation section 175a generates the ARP reply packet shown in the ARP reply packet shown in drawing 12 (b) based on the contact information concerned, and (c). Contact information-interchange section 103a transmits contact information to network connection equipment 100a in the form of the ARP reply packet concerned. In addition, in drawing 12 (b), 476a is a destination MAC Address (MAC_Broadcast), 476b is a transmitting agency MAC Address (MAC_V), and 476c is a source hardware address (MAC_V). 476d is a source protocol address (IP_V), 476e is a target hardware address (MAC_V), 476f is a target protocol address (IP_222), and it sets to drawing 12 (c). 477a is a destination MAC Address (MAC_Broadcast), 477b is a transmitting agency MAC Address (MAC_V), and 477c is a source hardware address (MAC_V). 477d is a source protocol address (IP_V), 477e is a target hardware address (MAC_V), and 477f is a target protocol address (IP_227).

[0065] And in the same procedure as the above-mentioned network connection equipment 200a, using contact information-interchange section 103a, subnet selection section 174a, and the packet transmitting section 104, the ARP reply packet concerned is transmitted and the ARP table of a terminal unit 221 is updated in network connection equipment 100a which received the ARP reply packet. Drawing 14 is drawing showing an example of the entry after updating (ARP table 223), 483a is an IP address (IP_222), and 483b is a MAC Address (MAC_V).

[0066] Thus, even when each terminal unit in a subnet 230 is divided by failure etc., the ARP table in each terminal unit is rewritten, it can write as the configuration which communicates via a backbone network 210, and the communication link between the distributed terminal units can be made to continue in the gestalt of this operation. Moreover, when it is the same as that of the above, the ARP reply packet which the terminal unit connected to the subnet generated with the network connection equipment connected to the divided terminal unit is written as the configuration which rewrites an ARP table in reception and general actuation of ARP, and a communication path can be changed, without adding special processing.

[0067] Gestalt 3. drawing 15 of operation is drawing showing the configuration of the gestalt 3 of operation of the network connection equipment concerning this invention. In drawing 15, 100b is network connection equipment, 501b is the ARP packet junction section, 107b is the Records Department which records contact information, 210b is a backbone network, 211b is a communication path to which between network connection equipment is connected, 230b is a subnet, 291b is input/output port linked to subnet 230b, and 293b is input/output port linked to a backbone network 210.

[0068] Moreover, drawing 16 is drawing showing the configuration of the above-mentioned ARP packet junction section 501b. In drawing 16, 518 is an ARP packet receive section, 519 is the retrieval section, 520 is the request transfer section, 521 is a backbone packet receive section,

522 is a reply packet transducer, 523 is the reply packet transmitting section, 524 is the subnet selection section, 525 is a request packet transducer, 526 is the request packet transmitting section, and 527 is the reply transfer section.

[0069] Moreover, drawing 17 is drawing showing an example of a network system which used the network connection equipment of the gestalt 3 of operation. In drawing 17, 200b is network connection equipment, and 240b and 250b are subnets. 504 is a subnet fragmentation part and 211b is a communication path to which between network connection equipment is connected. 531 is an ARP request packet transmitted from a terminal unit 221. 532 is an ARP request packet transmitted from network connection equipment 100b. 533 is an ARP request packet transmitted from network connection equipment 200b. 534 is an ARP reply packet transmitted from a terminal unit 222. 535 is an ARP reply packet transmitted from network connection equipment 200b. 536 by the ARP reply packet transmitted from network connection equipment 100b **, 291b is input/output port linked to subnet 230 of network connection equipment 100b b, and 292b is input/output port linked to subnet 230 of network connection equipment 200b b. In addition, about the same configuration as the gestalt 1 of the operation explained previously, the same sign is attached and the explanation is omitted.

[0070] Here, actuation of the above-mentioned network connection equipment is explained using drawing 15, drawing 16, and drawing 17. In addition, the gestalt of this operation explains only different actuation from the gestalt 1 of the above-mentioned operation. Moreover, the network connection equipments 100a and 100b take a redundant configuration, and the network system of the gestalt of this operation connects backbone network 210b and subnet 230b. moreover, network connection equipment 100b — as a standby router — network connection equipment 200b — present — business — as a router, it shall operate, respectively and the virtual MAC Address and the IP address shall be shared

[0071] First, in network connection equipment 100b, the condition check section 101 supervises switch-on with network connection equipment 200b via subnet 230b like the gestalt 1 of operation. And when subnet 230b is divided in the subnet fragmentation part 504 and divided like the A section of illustration, and the B section for example, in network connection equipment 100b, the condition check section 101 detects a failure and records the combination of an IP address and a MAC Address on Records Department 107b and the ARP table 108 as contact information in the same procedure as the gestalt 1 of the operation explained previously. then, network connection equipment 100b — present — business — actuation as a router is performed.

[0072] For example, when the terminal unit 221 is not communicating with a terminal unit 222, the entry equivalent to a mutual terminal unit is not registered into the ARP table of each terminal unit, and in each terminal unit, even when the ARP reply packet transmitted from the packet transmitting section 104 is received, an entry is not added to an ARP table.

[0073] On the other hand, when a terminal unit 221 newly communicates with a terminal unit 222, in a terminal unit 221, the ARP request packet 531 is transmitted to a terminal unit 222. Drawing 18 is drawing showing an example of a format of an ARP request packet and an ARP reply packet, and especially drawing 18 (a) is drawing showing an example of the ARP request packet 531. In drawing 18 (a), 531a is a destination MAC Address, 531b is a transmitting agency MAC Address, 531c is a source hardware address, 531d is a source protocol address, 531e is a target hardware address, and 531f is a target protocol address. Here, a broadcast address (MAC_BC) is set as destination MAC Address 531a, the MAC Address (MAC_221) of a terminal unit 221 is set as transmitting agency MAC Address 531b and source hardware address 531c, the IP address (IP_221) of a terminal unit 221 is set as source protocol address 531d, and the IP address (IP_222) of a terminal unit 222 is set as target protocol address 531f.

[0074] In APR packet junction section 501 of network connection equipment 100b which received ARP request packet 531 b, the ARP packet receive section 518 extracts target protocol address 531f in the ARP request packet 531 concerned. And if the IP address is not an IP address currently used by port 291b, it will search whether there is any entry to which the retrieval section 519 corresponds to target protocol address 531f at the entry recorded on Records Department 107b. In addition, since the terminal unit 222 has connected with the B section by

the side of network connection equipment 200b, a retrieval result here becomes having no applicable entry.

[0075] When there is no applicable entry, the ARP request packet 531 is transmitted to the request transfer section 520, and the ARP request packet 532 equivalent to the received ARP request packet 531 is transmitted to network connection equipment 200b in the request transfer section 520 in the retrieval section 519 through communication path 211b set up on backbone network 210b. Drawing 18 R> 8 (b) is drawing showing an example of the ARP request packet 532. In drawing 18 (b), 532a is a destination MAC Address, 532b is a transmitting agency MAC Address, 532c is a source hardware address, 532d is a source protocol address, 532e is a target hardware address, and 532f is a target protocol address. Here, a broadcast address (MAC_BC) is set as destination MAC Address 532a, the MAC Address (MAC_221) of a terminal unit 221 is set as transmitting agency MAC Address 532b and source hardware address 532c, the IP address (IP_221) of a terminal unit 221 is set as source protocol address 532d, and the IP address (IP_222) of a terminal unit 222 is set as target protocol address 532f.

[0076] In network connection equipment 200b which received the ARP request packet 532, the backbone packet receive section 521 notifies the ARP request packet 532 concerned to the subnet selection section 524. In the subnet selection section 524, target protocol address 532f is extracted from the received ARP request packet 532, and subnet 230b including the address concerned is chosen from the subnets which network connection equipment 200b holds. And the ARP request packet 532 is notified to the request packet transducer 525.

[0077] In the request packet transducer 525 of network connection equipment 200b, transmitting agency MAC Address 532b of the ARP request packet 532 and source hardware address 532c are rewritten to a virtual MAC Address (MAC_V). And in the request packet transmitting section 526, the ARP request packet 533 after rewriting is transmitted from port 292b linked to subnet 230b. Drawing 18 (c) is drawing showing an example of the ARP request packet 533. In drawing 18 (c), 533a is a destination MAC Address, 533b is a transmitting agency MAC Address, 533c is a source hardware address, 533d is a source protocol address, 533e is a target hardware address, and 533f is a target protocol address. Here, a broadcast address (MAC_BC) is set as destination MAC Address 533a, a virtual MAC Address (MAC_V) is set as transmitting agency MAC Address 533b and source hardware address 533c, the IP address (IP_221) of a terminal unit 221 is set as source protocol address 533d, and the IP address (IP_222) of a terminal unit 222 is set as target protocol address 533f.

[0078] In the terminal unit 222 which received the ARP request packet 533, the IP address of the terminal unit 221 stored in source protocol address 533d and the virtual MAC Address stored in source hardware address 533c are learned, and the study result is registered into an ARP table. And the ARP reply packet 534 is transmitted as a response to the received packet. Drawing 18 (d) is drawing showing an example of the ARP reply packet 534. In drawing 18 (d), 534a is a destination MAC Address, 534b is a transmitting agency MAC Address, 534c is a source hardware address, 534d is a source protocol address, 534e is a target hardware address, and 534f is a target protocol address. Here, the virtual MA address (MAC_V) is set as destination MAC Address 534a and target hardware address 534e, the MAC Address (MAC_222) of a terminal unit 222 is set as transmitting agency MAC Address 534b and source hardware address 534c, the IP address (IP_222) of a terminal unit 222 is set as source protocol address 534d, and the IP address (IP_221) of a terminal unit 221 is set as target protocol address 534f.

[0079] In APR packet junction section 501 of network connection equipment 200b which received ARP reply packet 534 b, the ARP packet receive section 518 extracts target protocol address 534f in the ARP reply packet 534 concerned. And if the IP address is not an IP address currently used by port 292b, the ARP reply packet 534 will be transmitted to the reply transfer section 527. In the reply transfer section 527, the ARP reply packet 535 equivalent to the received ARP reply packet 534 is transmitted to network connection equipment 100b through communication path 211b set up on backbone network 210b. Drawing 18 (e) is drawing showing an example of the ARP reply packet 535. In drawing 18 (e), 535a is a destination MAC Address, 535b is a transmitting agency MAC Address, 535c is a source hardware address, 535d is a source protocol address, 535e is a target hardware address, and 535f is a target protocol address. Here, a virtual

MAC Address (MAC_V) is set as destination MAC Address535a and target hardware address 535e, the MAC Address (MAC_222) of a terminal unit 222 is set as transmitting agency MAC Address535b and source hardware address 535c, the IP address (IP_222) of a terminal unit 222 is set as source protocol address 535d, and the IP address (IP_221) of a terminal unit 221 is set as target protocol address 535f.

[0080] In network connection equipment 100b which received the ARP reply packet 535, the backbone packet receive section 521 notifies the ARP reply packet 535 concerned to the subnet selection section 524. In the subnet selection section 524, target protocol address 535f is extracted from the received ARP reply packet 535, and subnet 230b including the address concerned is chosen from the subnets which network connection equipment 100b holds. And the ARP reply packet 535 is notified to the reply packet transducer 522.

[0081] In the reply packet transducer 522 of network connection equipment 100b, target protocol address 535f of the ARP reply packet 535 is extracted. Then, the retrieval section 519 gains the MAC Address corresponding to the target protocol address 535f concerned, and rewrites destination MAC Address535a and target hardware address 535e based on the acquisition result. Moreover, in the reply packet transducer 522, transmitting agency MAC Address 535b and source hardware address 535c are rewritten to virtual MAC Address MAC_V currently used by port 291b. And in the reply packet transmitting section 523, the ARP reply packet 536 after rewriting is transmitted from port 291b linked to subnet 230b. Drawing 18 (f) is drawing showing an example of the ARP reply packet 536. In drawing 18 R> 8 (f), 536a is a destination MAC Address, 536b is a transmitting agency MAC Address, 536c is a source hardware address, 536d is a source protocol address, 536e is a target hardware address, and 536f is a target protocol address. Here, the MAC Address (MAC_221) of a terminal unit 221 is set as destination MAC Address536a and target hardware address 536e, a virtual MAC Address (MAC_V) is set as transmitting agency MAC Address536b and source hardware address 536c, the IP address (IP_222) of a terminal unit 222 is set as source protocol address 536d, and the IP address (IP_221) of a terminal unit 221 is set as target protocol address 536f.

[0082] In the terminal unit 221 which received the ARP reply packet 536, the virtual MAC Address stored in source hardware address 536c is learned as a MAC Address corresponding to the IP address of a terminal unit 222, and it registers with an ARP table.

[0083] Henceforth, packet transmission to a terminal unit 222 from a terminal unit 221 is performed to a virtual MAC Address, and it is the same procedure as the gestalt 1 of operation, and hooks up to the network connection equipments 100b and 200b. Moreover, also with the packet transmission to a terminal unit 221 from a terminal unit 222, since the virtual MAC Address is registered into the ARP table, it is carried out to a virtual MAC Address. Thereby, a mutual communication link is attained.

[0084] Thus, in the gestalt of this operation, even when subnet 230b is divided, each network connection equipment can write as the configuration which relays an ARP packet via a backbone network, and it can newly communicate between the divided terminal units with which the entry is not registered from the first. Moreover, in the gestalt of this operation, address solution can be performed through a backbone network also with the terminal unit set up so that it might not answer to the ICMP request message transmitted to the broadcast address. Moreover, in the terminal unit connected to the subnet, it is transmitting and receiving an ARP request packet and an ARP response packet, and since an ARP table is updated, the communication link using a backbone network is attained, without adding special processing.

[0085] Gestalt 4. drawing 19 of operation is drawing showing the configuration of the gestalt 4 of operation of the network connection equipment concerning this invention. In drawing 19, 100c is network connection equipment, 101c is the condition check section, 103c is the contact information-interchange section, 104c is the packet transmitting section, 107c is the Records Department, 174c is the subnet selection section, 175c is the transfer packet generation section, and 641c is the recovery packet generation section. in addition, about above-mentioned network connection equipment 100c, condition check section 101c, contact information-interchange section 103c, packet transmitting section 104c, Records Department 107c, subnet selection section 174c, and transfer packet generation section 175c It is premised on including

the same function as the condition check section in the gestalten 1 or 2 of the operation previously explained, respectively in addition to the characteristic function in the gestalt of this operation, the contact information-interchange section, the packet transmitting section, the Records Department, the subnet selection section, and the transfer packet generation section.

[0086] Moreover, drawing 20 is drawing showing an example of a network system which used the network connection equipment of the gestalt 4 of operation. In drawing 20, 200c is network connection equipment. In addition, about the same configuration as the gestalten 1 or 2 of the operation explained previously, the same sign is attached and the explanation is omitted.

[0087] Here, actuation of the above-mentioned network connection equipment is explained using drawing 19 and drawing 20. In addition, the gestalt of this operation explains only different actuation from the gestalten 1 or 2 of the operation explained previously. Moreover, the network connection equipments 100c and 200c take a redundant configuration, and the network system of the gestalt of this operation connects a backbone network 210 and a subnet 230. moreover — the gestalt of this operation — network connection equipment 100c — as a standby router — network connection equipment 200c — present — business — as a router, it operates, respectively and is further premised on the condition that the switching hub 232 broke down. Namely, it is premised on the condition that the entry shown in the ARP table 223 of a terminal unit 221 at drawing 21 (a) was registered in the same procedure as the gestalt 2 of operation, the entry shown in the ARP table 224 of a terminal unit 222 at drawing 22 (a) was registered, the entry shown in drawing 23 was registered into Records Department 107 of network connection equipment 100c c, and the entry shown in drawing 24 was registered into Records Department 107 of network connection equipment 200c c.

[0088] However, drawing 21 is drawing showing an example of the entry recorded on the ARP table of a terminal unit 221, in the entry at the time of failure generating shown in drawing 21 (a), 625a is an IP address, 626a is [625b is a MAC Address,] an IP address in the entry of forward always shown in drawing 21 (b), and 626b is a MAC Address. Moreover, drawing 22 is drawing showing an example of the entry recorded on the ARP table of a terminal unit 222, in the entry at the time of failure generating shown in drawing 22 (a), 627a is an IP address, 628a is [627b is a MAC Address,] an IP address in the entry of forward always shown in drawing 22 (b), and 628b is a MAC Address. Moreover, drawing 23 is the example of the entry recorded on Records Department 107 of network connection equipment 100c c, in drawing 23, 652a is an IP address and 652b is a MAC Address. Moreover, drawing 24 is the example of the entry recorded on Records Department 107 of network connection equipment 200c c, in drawing 24, 653a is an IP address and 653b is a MAC Address.

[0089] In this condition, if a switching hub 232 is recovered, in condition check section 101 of network connection equipment 100c c, the flow of ping, the VRRP message reception from network connection equipment 200c, etc. will detect failure recovery of a subnet 230, and the purport to which self-equipment operates as a standby router to network connection equipment 200c via a communication path 211 will be notified.

[0090] In network connection equipment 200c which received the above-mentioned notice, condition check section 101c notifies that to recovery packet generation section 641c. In recovery packet generation section 641c, an ARP reply packet is generated with reference to Records Department 107c of self-equipment based on an entry. Drawing 25 is drawing showing an example of an ARP reply packet format. the ARP reply packet of network connection equipment 100c shown in drawing 25 (a) — it is, 660a is a destination MAC Address, 660b is a transmitting agency MAC Address, 660c is a source hardware address, 660d is a source protocol address, 660e is a target hardware address, and 660f is a target protocol address. the ARP reply packet of network connection equipment 200c shown in drawing 25 (b) — it is, 661a is a destination MAC Address, 661b is a transmitting agency MAC Address, 661c is a source hardware address, 661d is a source protocol address, 661e is a target hardware address, and 661f is a target protocol address.

[0091] Here, as shown in drawing 25 (b), IP address 653a (IP_222) is set as target protocol address 661f. MAC Address 653b (MAC_222) is set as target hardware address 661e. The IP address (IP_V) currently used for source protocol address 661d in the port 292 is set up. The

virtual MAC Address (MAC_V) currently used for source hardware address 661c and transmitting agency MAC Address 661b in the port 292 is set up, and a broadcast address (MAC_Broadcast) is set as destination MAC Address 661a.

[0092] In packet transmitting section 104 of network connection equipment 200c, the ARP reply packet generated as mentioned above is transmitted from a port 292.

[0093] At this time, the entry of the ARP table shown in drawing 21 (a) is updated like drawing 21 (b) with the terminal unit 221 which received the ARP reply packet based on target hardware address 661e and target protocol address 661f contained in the packet concerned.

[0094] On the other hand, since network connection equipment 100c becomes a standby router, it cannot perform the communication link which used the virtual address on the subnet 230.

Then, the information which network connection equipment 100c holds is transmitted to network connection equipment 200c, and an ARP reply packet is transmitted from network connection equipment 200c. Speaking concretely, by network connection equipment 100c, transfer packet generation section 175c's generating an ARP reply packet based on the entry currently recorded on Records Department 107c, if condition check section 101c detects failure recovery of a subnet 230. Here, as shown in drawing 25 (a), IP address 652a (IP_221) is set as target protocol address 660f, MAC Address 652b (MAC_221) is set as target hardware address 660e, a virtual IP address (IP_V) is set as source protocol address 660d, a virtual MAC Address (MAC_V) is set as source hardware address 660c and transmitting agency MAC Address 660b, and a broadcast address (MAC_Broadcast) is set as destination MAC Address 660a.

[0095] In contact information-interchange section 103 of network connection equipment 100c, contact information is transmitted to network connection equipment 200c in the form of the ARP reply packet generated as mentioned above.

[0096] In network connection equipment 200c which received the above-mentioned contact information, i.e., an ARP reply packet, since subnet selection section 174c is reception from a backbone network 210 and a transmitting agency MAC Address is a virtual MAC Address of a port 292, it identifies that the destination is a subnet 230. And in packet transmitting section 104c, the packet concerned is transmitted from a port 292.

[0097] In the terminal unit 222 which received the ARP reply packet, the entry of the ARP table shown in drawing 22 (a) is updated like drawing 22 (b) based on target hardware address 660e and target protocol address 660f contained in the packet concerned.

[0098] Thus, in the gestalt of this operation, when the failure of a subnet 230 is recovered, each terminal unit can write as the configuration which rewrites the entry of the ARP table updated by the failure in the condition (always [forward]) of a basis, and can continue the communication link between terminal units by direct assignment of a mutual MAC Address henceforth. Moreover, in the gestalt of this operation, it writes as the configuration which rewrites an ARP table by general actuation of ARP, and each terminal unit connected to the subnet 230 can choose a communication path, without adding special processing.

[0099] Gestalt 5. drawing 26 of operation is drawing showing the configuration of the gestalt 5 of operation of the network connection equipment concerning this invention. In drawing 26, 100d is network connection equipment, 103d is the contact information-interchange section, 173d is the packet generation section, and 174d is the subnet selection section.

[0100] Moreover, drawing 27 is drawing showing an example of a network system which used the network connection equipment of the gestalt 5 of operation. In drawing 27, 200d is network connection equipment. In addition, about the same configuration as the gestalten 1-4 of the operation explained previously, the same sign is attached and the explanation is omitted.

[0101] Here, actuation of the above-mentioned network connection equipment is explained using drawing 26 and drawing 27. In addition, the gestalt of this operation explains only different actuation from the gestalten 1-4 of the operation explained previously. Moreover, the network system of the gestalt of this operation takes 100d of network connection equipment, and a configuration with redundant 200d, and connects a backbone network 210 and a subnet 230. moreover -- the gestalt of this operation -- 100d of network connection equipment -- as a standby router -- 200d of network connection equipment -- present -- business -- as a router, it operates, respectively and is further premised on the condition that the switching hub 232

broke down. Namely, it is premised on the condition that the entry shown in the ARP table 223 of a terminal unit 221 at drawing 21 (a) was registered in the same procedure as the gestalt 2 of operation, the entry shown in the ARP table 224 of a terminal unit 222 at drawing 22 (a) was registered, the entry shown in drawing 23 was registered into Records Department 107of network connection equipment 100c c, and the entry shown in drawing 24 R> 4 was registered into Records Department 107of network connection equipment 200c c.

[0102] In this condition, if a switching hub 232 is recovered, by 100d of network connection equipment, the ARP reply packet shown in drawing 25 will be generated like the gestalt 4 of the above-mentioned operation, and the ARP reply packet concerned will be transmitted from a port 292. And in a terminal unit 221, the entry of the ARP table shown in drawing 21 (a) is updated like drawing 21 (b).

[0103] On the other hand, since 100d of network connection equipment serves as a standby router, it cannot perform the communication link which used the virtual address on the subnet 230. So, with 200d of network connection equipment, if condition check section 101c detects failure recovery of a subnet 230, 103d of contact information-interchange sections will generate contact information based on the entry currently recorded on Records Department 107c, and they will transmit the contact information concerned to 200d of network connection equipment. That is, with reference to the contents of the entry of drawing 23 , IP address 652a and MAC Address 652b are transmitted as contact information.

[0104] At 103d of contact information-interchange sections of 200d of network connection equipment which received contact information, the IP address included in the information concerned is transmitted to 174d of subnet selection sections, and in 174d of subnet selection sections, the subnet 230 in which the received IP address is included is chosen from the subnets which 100d of network connection equipment holds, and it notifies to 173d of packet generation sections.

[0105] In 173d of packet generation sections of 200d of network connection equipment, as shown in drawing 25 (a), an ARP reply packet is generated. And in packet transmitting section 104c, the received ARP reply packet is transmitted from a port 292.

[0106] In the terminal unit 222 which received the ARP reply packet, the entry of the ARP table shown in drawing 22 (a) is updated like drawing 22 (b) based on target hardware address 660e and target protocol address 660f contained in the packet concerned.

[0107] Thus, while writing as contact information as the configuration which sends only the combination of an IP address and a MAC Address and acquiring the same effectiveness as the gestalt 4 of the above-mentioned operation, as compared with the case where an ARP packet is transmitted, the traffic volume of a backbone network is sharply reducible in the gestalt of this operation, further. Moreover, in the gestalt of this operation, by the case where an ARP reply packet is generated based on the entry recorded on the Records Department of self-equipment, and the case where an ARP reply packet is generated based on the contact information acquired from other network connection equipments, since processing is the same, mounting can be simplified.

[0108]

[Effect of the Invention] As mentioned above, even when each terminal unit in a subnet is divided by failure etc. according to this invention as explained, the effectiveness of the ability to write as the configuration which communicates via a backbone network, and make the communication link between the distributed terminal units continuing is done so. Moreover, when it is the same as that of the above, the terminal unit connected to the subnet writes the ARP reply packet generated with the network connection equipment connected to self as the configuration which rewrites an ARP table in reception and general actuation of ARP, and does so the effectiveness that a communication path can be changed without adding special processing.

[0109] According to the next invention, even when a subnet is divided, the effectiveness that each network connection equipment can write as the configuration which relays an ARP packet via a backbone network, and can newly communicate between the divided terminal units with which the entry is not registered from the first is done so. Moreover, the effectiveness that

address solution can be performed through a backbone network also with the terminal unit set up so that it might not answer to the ICMP request message transmitted to the broadcast address is done so. Moreover, in the terminal unit connected to the subnet, it is transmitting and receiving an ARP request packet and an ARP response packet, and in order to update an ARP table, the effectiveness that the communication link using a backbone network is attained without adding special processing is done so.

[0110] According to the next invention, even when each terminal unit in a subnet is divided by failure etc., the ARP table in each terminal unit is rewritten, and the effectiveness of the ability to write as the configuration which communicates via a backbone network, and make the communication link between the distributed terminal units continuing is done so. Moreover, the terminal unit connected to the subnet when it was the same as that of the above writes the ARP reply packet generated with the network connection equipment connected to the divided terminal unit as the configuration which rewrites an ARP table in reception and general actuation of ARP, and does so the effectiveness that a communication path can be changed without adding special processing.

[0111] According to the next invention, when the failure of a subnet is recovered, each terminal unit writes as the configuration which rewrites the entry of the ARP table updated by the failure in the condition (always [forward]) of a basis, and does so henceforth the effectiveness that the communication link between terminal units is continuable, by direct assignment of a mutual MAC Address. Moreover, each terminal unit connected to the subnet writes as the configuration which rewrites an ARP table by general actuation of ARP, and does so the effectiveness that a communication path can be chosen without adding special processing.

[0112] According to the next invention, it writes as contact information as the configuration which sends only the combination of an IP address and a MAC Address, and the effectiveness that the traffic volume of a backbone network is sharply reducible further as compared with the case where an ARP packet is transmitted is done so. Moreover, by the case where an ARP reply packet is generated based on the contact information collected with self-equipment, and the case where an ARP reply packet is generated based on the contact information acquired from other network connection equipments, since processing is the same, the effectiveness that mounting can be simplified is done so.

[0113] According to the next invention, an ICMP echo request message is transmitted by the broadcast address at the time of contact information gathering, it writes as the configuration which collects to coincidence the ICMP echo reply messages from each terminal unit connected to the subnet, and the effectiveness that contact information is efficiently collectable is done so.

[0114] According to the next invention, even when each terminal unit in a subnet is divided by failure etc., the effectiveness of the ability to write as the configuration which communicates via a backbone network, and make the communication link between the distributed terminal units continuing is done so.

[0115] According to the next invention, even when a subnet is divided, the effectiveness that each network connection equipment can write as the configuration which relays an ARP packet via a backbone network, and can newly communicate between the divided terminal units with which the entry is not registered from the first is done so. Moreover, the effectiveness that address solution can be performed through a backbone network also with the terminal unit set up so that it might not answer to the ICMP request message transmitted to the broadcast address is done so.

[0116] According to the next invention, even when each terminal unit in a subnet is divided by failure etc., the ARP table in each terminal unit is rewritten, and the effectiveness of the ability to write as the configuration which communicates via a backbone network, and make the communication link between the distributed terminal units continuing is done so.

[0117] According to the next invention, when the failure of a subnet is recovered, it writes as the configuration controlled to rewrite the entry of the ARP table on which each terminal unit was updated by the failure in the condition (always [forward]) of a basis, and the effectiveness that the communication link between terminal units is continuable is henceforth done so by

direct assignment of a mutual MAC Address.

[0118] According to the next invention, it writes as contact information as the configuration which sends only the combination of an IP address and a MAC Address, and the effectiveness that the traffic volume of a backbone network is sharply reducible further as compared with the case where an ARP packet is transmitted is done so. Moreover, by the case where an ARP reply packet is generated based on the contact information collected with self-equipment, and the case where an ARP reply packet is generated based on the contact information acquired from other network connection equipments, since processing is the same, the effectiveness that mounting can be simplified is done so.

[0119] According to the next invention, an ICMP echo request message is transmitted by the broadcast address at the time of contact information gathering, it writes as the configuration which collects to coincidence the ICMP echo reply messages from each terminal unit connected to the subnet, and the effectiveness that contact information is efficiently collectable is done so.

[Translation done.]

*** NOTICES ***

JPO and NCIP I are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention] This invention relates to the network system and network connection equipment between the terminals at the time of subnet fragmentation which can relieve a communication link especially about the network system equipped with two or more network connection equipments which make redundancy connection of a backbone network and the subnet.

[Translation done.]

* NOTICES *

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

PRIOR ART

[Description of the Prior Art] Hereafter, the conventional technique is explained. In IP (Internet Protocol) network, other networks and the divided subnet communicate with the exterior of the subnet concerned via a router with a router. However, since it becomes impossible to communicate with the exterior of a subnet when a router breaks down, generally performing redundancy-ization of a communication path using two or more routers is known.

[0003] As a system which performs redundancy-ization of a communication path using two or more routers, "the router network which has Subordinate's LAN relief function in a router failure" of a publication is in JP,11-261620,A, for example. Drawing 28 R> 8 is drawing showing the conventional structure of a system. drawing 28 -- setting -- 10 -- present -- business -- it is a router, 11 is a substitute router, 12 is other routers, 13 is an ATM network, and 14 is the subnet by which the router was redundancy-ized.

[0004] a technique given [above-mentioned] in an official report -- a subnet 14 -- one -- present -- business -- a router 10 -- present -- business -- substitute router 11 with an another router 10 is prepared. this time -- present -- business -- the network environment of a router 10 -- the substitute router 11 -- beforehand -- setting up -- the substitute router 11 -- a ping packet etc. -- present -- business -- a router 10 is supervised. and -- present -- business -- the case where a router 10 becomes a failure -- present -- business -- the MAC (Media Access Control) address which was being used with the router 10 -- the substitute router 11 -- succeeding -- the substitute router 11 -- present -- business -- it takes the place and operates to a router 10. if it says concretely -- present -- business -- the case where a router 10 becomes a failure -- the substitute router 11 -- present -- business -- the physical address currently used with the router 10 is succeeded, and junction of the communication link frame to the outside of a subnet is executed by proxy. Thereby, the connectability of a subnet 14 and other subnets is securable.

[0005] Moreover, as a system which performs redundancy-ization of a communication path using two or more routers, there is a network system which used VRRP (Virtual Router Redundancy Protocol, Internet Engineering Task Force:IETF RFC2338) in addition to the above.

[0006] Two or more routers constitute a virtual router, and VRRP shares a virtual MAC Address and a common IP address. present -- business -- a router transmits a VRRP message into a subnet periodically -- a virtual MAC Address and an IP address -- a standby router -- notifying -- present -- business -- **** of a router is made to know on the other hand -- a standby router -- fixed time amount -- present -- business -- there is no arrival of the VRRP message from a router -- having -- present -- business -- the failure of a router is detected and substitute actuation is performed using a virtual MAC Address and an IP address.

[0007] Drawing 29 is drawing showing the configuration of the network system which used VRRP. In drawing 29, 20 and 21 are routers, 23, 24, and 25 are switching hubs, 26 and 27 are terminal units, 28 is a subnet, and 29 is a backbone network.

[0008] Moreover, drawing 30 is drawing showing the outline of an ARP (Address Resolution Protocol) reply packet format in which it is used by VRRP. In drawing 30, 30a is a destination MAC Address (MAC_DA), 30b is a transmitting agency MAC Address (MAC_SA), 30c is a source hardware address (solvent refined coal_MAC_ADDR), 30d is a source protocol address (solvent

refined coal_IP_ADDR), 30e is a target hardware address (TAGT_MAC_ADDR), and 30f is a target protocol address (TAGT_IP_ADDR).

[0009] In terminal units 26 and 27, if the virtual MAC Address is set up as a default route, the communication link frame to the outside of a subnet will be transmitted to a virtual MAC Address. for example, the router 20 — present — business — as a router, when the router 21 is operating as a standby router, a router 20 relays a communication link frame.

[0010] and — present — business — failure of a router 20 transmits the ARP reply packet shown in drawing 30 to a subnet 28 in the standby router 21. That is, in the standby router 21, a virtual MAC Address is stored in transmitting agency MAC Address30b and source hardware address 30c, a share IP address is stored in source protocol address 30d, a broadcast address is stored in destination MAC Address 30a, and an ARP reply packet is transmitted to a subnet 28 in this condition.

[0011] Moreover, in each switching hub, the above-mentioned ARP reply packet is received and transmitted, it learns that the equipment of a virtual MAC Address is in the port of the direction of a router 21, and the MAC frame addressed to a virtual MAC Address is henceforth transmitted in the direction of a router 21. thereby — present — business — when a router 20 breaks down, the connectability of a subnet 27 and other subnets can be secured.

[Translation done.]

*** NOTICES ***

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.*** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, even when each terminal unit in a subnet is divided by failure etc. according to this invention as explained, the effectiveness of the ability to write as the configuration which communicates via a backbone network, and make the communication link between the distributed terminal units continuing is done so. Moreover, when it is the same as that of the above, the terminal unit connected to the subnet writes the ARP reply packet generated with the network connection equipment connected to self as the configuration which rewrites an ARP table in reception and general actuation of ARP, and does so the effectiveness that a communication path can be changed without adding special processing.

[0109] According to the next invention, even when a subnet is divided, the effectiveness that each network connection equipment can write as the configuration which relays an ARP packet via a backbone network, and can newly communicate between the divided terminal units with which the entry is not registered from the first is done so. Moreover, the effectiveness that address solution can be performed through a backbone network also with the terminal unit set up so that it might not answer to the ICMP request message transmitted to the broadcast address is done so. Moreover, in the terminal unit connected to the subnet, it is transmitting and receiving an ARP request packet and an ARP response packet, and in order to update an ARP table, the effectiveness that the communication link using a backbone network is attained without adding special processing is done so.

[0110] According to the next invention, even when each terminal unit in a subnet is divided by failure etc., the ARP table in each terminal unit is rewritten, and the effectiveness of the ability to write as the configuration which communicates via a backbone network, and make the communication link between the distributed terminal units continuing is done so. Moreover, the terminal unit connected to the subnet when it was the same as that of the above writes the ARP reply packet generated with the network connection equipment connected to the divided terminal unit as the configuration which rewrites an ARP table in reception and general actuation of ARP, and does so the effectiveness that a communication path can be changed without adding special processing.

[0111] According to the next invention, when the failure of a subnet is recovered, each terminal unit writes as the configuration which rewrites the entry of the ARP table updated by the failure in the condition (always [forward]) of a basis, and does so henceforth the effectiveness that the communication link between terminal units is continuable, by direct assignment of a mutual MAC Address. Moreover, each terminal unit connected to the subnet writes as the configuration which rewrites an ARP table by general actuation of ARP, and does so the effectiveness that a communication path can be chosen without adding special processing.

[0112] According to the next invention, it writes as contact information as the configuration which sends only the combination of an IP address and a MAC Address, and the effectiveness that the traffic volume of a backbone network is sharply reducible further as compared with the case where an ARP packet is transmitted is done so. Moreover, by the case where an ARP reply packet is generated based on the contact information collected with self-equipment, and the case where an ARP reply packet is generated based on the contact information acquired from

other network connection equipments, since processing is the same, the effectiveness that mounting can be simplified is done so.

[0113] According to the next invention, an ICMP echo request message is transmitted by the broadcast address at the time of contact information gathering, it writes as the configuration which collects to coincidence the ICMP echo reply messages from each terminal unit connected to the subnet, and the effectiveness that contact information is efficiently collectable is done so.

[0114] According to the next invention, even when each terminal unit in a subnet is divided by failure etc., the effectiveness of the ability to write as the configuration which communicates via a backbone network, and make the communication link between the distributed terminal units continuing is done so.

[0115] According to the next invention, even when a subnet is divided, the effectiveness that each network connection equipment can write as the configuration which relays an ARP packet via a backbone network, and can newly communicate between the divided terminal units with which the entry is not registered from the first is done so. Moreover, the effectiveness that address solution can be performed through a backbone network also with the terminal unit set up so that it might not answer to the ICMP request message transmitted to the broadcast address is done so.

[0116] According to the next invention, even when each terminal unit in a subnet is divided by failure etc., the ARP table in each terminal unit is rewritten, and the effectiveness of the ability to write as the configuration which communicates via a backbone network, and make the communication link between the distributed terminal units continuing is done so.

[0117] According to the next invention, when the failure of a subnet is recovered, it writes as the configuration controlled to rewrite the entry of the ARP table on which each terminal unit was updated by the failure in the condition (always [forward]) of a basis, and the effectiveness that the communication link between terminal units is continuable is henceforth done so by direct assignment of a mutual MAC Address.

[0118] According to the next invention, it writes as contact information as the configuration which sends only the combination of an IP address and a MAC Address, and the effectiveness that the traffic volume of a backbone network is sharply reducible further as compared with the case where an ARP packet is transmitted is done so. Moreover, by the case where an ARP reply packet is generated based on the contact information collected with self-equipment, and the case where an ARP reply packet is generated based on the contact information acquired from other network connection equipments, since processing is the same, the effectiveness that mounting can be simplified is done so.

[0119] According to the next invention, an ICMP echo request message is transmitted by the broadcast address at the time of contact information gathering, it writes as the configuration which collects to coincidence the ICMP echo reply messages from each terminal unit connected to the subnet, and the effectiveness that contact information is efficiently collectable is done so.

[Translation done.]

* NOTICES *

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.*** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, in the above and the system by which redundancy connection of two or more routers was made, when a subnet was divided, in spite of having connected physically each terminal unit linked to a separate segment via other networks, there was a problem of it becoming impossible to perform a mutual communication link.

[0013] For example, in drawing 29 , when a switching hub 24 breaks down, the ARP request packet from a terminal unit 26 to a terminal unit 27 cannot communicate by flowing becoming impossible. Moreover, although a terminal unit 26 sets the MAC Address of a terminal unit 27 as a destination MAC Address and transmits the packet to a terminal unit 27 about the case where the entry of a terminal unit 27 is stored in the ARP table of a terminal unit 26, the junction of the packet concerned will become impossible by failure of a switching hub 24, and a communication link will stop.

[0014] This invention is made in view of the above, and in the system by which redundancy connection of a subnet and other networks was made, when each terminal is divided by failure within a subnet, it aims at obtaining the network connection equipment which can continue the communication link between terminals.

[Translation done.]

* NOTICES *

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem] If it is in the network system concerning this invention in order to solve the technical problem mentioned above and to attain the purpose A backbone network and the subnet which holds two or more terminal units, It has two or more network connection equipments which make redundancy connection of a backbone network and the subnet. Said each network connection equipment Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means (equivalent to the condition check section 101 of the gestalt of operation mentioned later) to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information (equivalent to the contact information gathering section 102), A contact information-interchange means to exchange the collected contact information for other network connection equipments connected to the same subnet using a backbone network (equivalent to the contact information-interchange section 103), A subnet selection means to choose a subnet based on the equipment initial entry received from other network connection equipments (equivalent to the subnet selection section 174), An ARP reply packet generation / transmitting means to transmit to the subnet which the ARP reply packet was generated [subnet] based on said contact information, and had the ARP reply packet concerned chosen (equivalent to the packet generation section 173 and the packet transmitting section 104), A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit (equivalent to a comparator 106), An IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network when each IP addresses differ (equivalent to the junction section 105), A preparation and said each terminal unit update an ARP table based on the received ARP reply packet, and are henceforth characterized by communicating with the divided terminal unit through a backbone network.

[0016] If it is in the network system concerning the next invention Furthermore, an ARP packet receiving means to receive an ARP request packet or an ARP reply packet from a subnet, and to extract a target protocol address from the packet concerned (equivalent to the ARP packet receive section 518), When said ARP packet receiving means receives an ARP request packet The 1st retrieval means which searches whether the information applicable to the target protocol address concerned was included in said collected contact information (equivalent to the Banking Inspection Department 519), A request transfer means to transmit said ARP request packet to a backbone network when said information is not included (equivalent to the request transfer section 520), A reply transfer means to transmit the ARP reply packet concerned to a backbone network when said ARP packet receiving means receives an ARP reply packet (equivalent to the reply transfer section 527), A backbone packet receiving means to receive an ARP request packet or an ARP reply packet from a backbone network (equivalent to the backbone packet receive section 521), A target protocol address is extracted from the ARP packet which received. A subnet selection means to choose the subnet in which the target protocol address concerned is contained from the single to hold or two or more subnets

(equivalent to the subnet selection section 524), When said backbone packet receiving means receives an ARP request packet The request packet conversion means which rewrites the transmitting agency MAC Address and source hardware address of the packet concerned to a virtual MAC Address (equivalent to the request packet transducer 525), A request packet transmitting means to transmit to the subnet which had the ARP request packet after rewriting chosen (equivalent to the request packet transmitting section 526), When said backbone packet receiving means receives an ARP reply packet The 2nd retrieval means which searches a MAC Address based on the target protocol address which said subnet selection means extracted (equivalent to the retrieval section 519), A destination MAC Address and a target hardware address are rewritten to the MAC Address which it is as a result of retrieval. The reply packet conversion means which rewrites a source hardware address to a virtual MAC Address (equivalent to the reply packet transducer 522), It is characterized by having a reply packet transmitting means (equivalent to the reply packet transmitting section 523) to transmit to the subnet which had the ARP reply packet after rewriting chosen.

[0017] If it is in the network system concerning the next invention A backbone network and the subnet which holds two or more terminal units, It has two or more network connection equipments which make redundancy connection of a backbone network and the subnet. Said each network connection equipment Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means (equivalent to condition check section 101a) to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A packet generation means to generate an ARP reply packet based on the collected contact information (equivalent to transfer packet generation section 175a), The packet operator stage which exchanges the generated ARP reply packet for other network connection equipments connected to the same subnet using a backbone network (equivalent to contact information-interchange section 103a), A subnet selection means to choose a subnet based on the ARP reply packet received from other network connection equipments (equivalent to subnet selection section 174a), An ARP reply packet transmitting means to transmit to the subnet which had said ARP reply packet chosen (equivalent to the packet transmitting section 104), A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, An IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network when each IP addresses differ, A preparation and said each terminal unit update an ARP table based on the received ARP reply packet, and are henceforth characterized by communicating with the divided terminal unit through a backbone network.

[0018] If it is in the network system concerning the next invention Furthermore, a recovery packet generation means to generate the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered (equivalent to recovery packet generation section 641c), A preparation and said ARP reply packet transmitting means The ARP reply packet generated by said recovery packet generation means, And the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned which received from the backbone network, It is characterized by for said each terminal unit returning an ARP table based on the received ARP reply packet, and communicating by transmitting to a subnet and specifying each other MAC Address directly between the terminal units on the same subnet henceforth.

[0019] If it is in the network system concerning the next invention Furthermore, the 1st recovery packet generation means which generates the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered (equivalent to recovery packet generation section 641c), When the contact information for returning the ARP table of the terminal unit connected to the subnet concerned is received from a backbone network The 2nd recovery packet generation means which generates an ARP reply packet based on the contact information concerned (equivalent to 173d of packet generation sections), A

preparation and said ARP reply packet generation / transmitting means The ARP reply packet generated by said 1st recovery packet generation means, The ARP reply packet generated by the 2nd recovery packet generation means is transmitted to a subnet. And said each terminal unit It is characterized by returning an ARP table based on the received ARP reply packet, and communicating by specifying each other MAC Address directly between the terminal units on the same subnet henceforth.

[0020] In the network system concerning the next invention said contact information gathering means A request transmitting means to transmit an ICMP echo request message by the broadcast address (equivalent to the request transmitting section 441), A receiving means to receive an ICMP echo reply message as a response to said request (equivalent to a receive section 442), It is characterized by having a study means (equivalent to the study section 443) to learn the combination of the IP address of the terminal unit in a subnet, and a MAC Address based on said ICMP echo reply message.

[0021] If it is in the network connection equipment concerning the next invention Redundancy connection of a backbone network and the subnet which holds two or more terminal units is made. For example Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A contact information-interchange means to exchange the collected contact information for other network connection equipments connected to the same subnet using a backbone network, A subnet selection means to choose a subnet based on the equipment initial entry received from other network connection equipments, An ARP reply packet generation / transmitting means to transmit to the subnet which the ARP reply packet was generated [subnet] based on said contact information, and had the ARP reply packet concerned chosen, A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, When each IP addresses differ, it is characterized by having an IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network.

[0022] If it is in the network connection equipment concerning the next invention Furthermore, an ARP packet receiving means to receive an ARP request packet or an ARP reply packet from a subnet, and to extract a target protocol address from the packet concerned, The 1st retrieval means which searches whether the information applicable to the target protocol address concerned was included in said collected contact information when said ARP packet receiving means received an ARP request packet, A request transfer means to transmit said ARP request packet to a backbone network when said information is not included, A reply transfer means to transmit the ARP reply packet concerned to a backbone network when said ARP packet receiving means receives an ARP reply packet, A backbone packet receiving means to receive an ARP request packet or an ARP reply packet from a backbone network, A subnet selection means to choose the subnet in which the target protocol address concerned is contained from the single which extracts and holds a target protocol address from the ARP packet which received, or two or more subnets, The request packet conversion means which rewrites the transmitting agency MAC Address and source hardware address of the packet concerned to a virtual MAC Address when said backbone packet receiving means receives an ARP request packet, A request packet transmitting means to transmit to the subnet which had the ARP request packet after rewriting chosen, The 2nd retrieval means which searches a MAC Address based on the target protocol address which said subnet selection means extracted when said backbone packet receiving means receives an ARP reply packet, The reply packet conversion means which rewrites a destination MAC Address and a target hardware address to the MAC Address which it is as a result of retrieval, and rewrites a source hardware address to a virtual MAC Address, It is characterized by having a reply packet transmitting means to transmit to the subnet which had the ARP reply packet after rewriting chosen.

[0023] If it is in the network connection equipment concerning the next invention Redundancy

connection of a backbone network and the subnet which holds two or more terminal units is made. For example Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A packet generation means to generate an ARP reply packet based on the collected contact information, The packet operator stage which exchanges the generated ARP reply packet for other network connection equipments connected to the same subnet using a backbone network, A subnet selection means to choose a subnet based on the ARP reply packet received from other network connection equipments, An ARP reply packet transmitting means to transmit to the subnet which had said ARP reply packet chosen, A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, When each IP addresses differ, it is characterized by having an IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network.

[0024] If it is in the network connection equipment concerning the next invention Furthermore, a recovery packet generation means to generate the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered, A preparation and said ARP reply packet transmitting means It is characterized by transmitting to a subnet the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned which received from the ARP reply packet generated by said recovery packet generation means, and the backbone network.

[0025] If it is in the network connection equipment concerning the next invention Furthermore, the 1st recovery packet generation means which generates the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered, When the contact information for returning the ARP table of the terminal unit connected to the subnet concerned is received from a backbone network It has the 2nd recovery packet generation means which generates an ARP reply packet based on the contact information concerned. Said ARP reply packet generation / transmitting means It is characterized by transmitting to a subnet the ARP reply packet generated by said 1st recovery packet generation means, and the ARP reply packet generated by the 2nd recovery packet generation means.

[0026] In the network connection equipment concerning the next invention, it carries out that said contact information gathering means is equipped with a request transmitting means to transmit an ICMP echo request message by the broadcast address, a receiving means to receive an ICMP echo reply message as a response to said request, and a study means learn the combination of the IP address of the terminal unit in a subnet, and a MAC Address based on said ICMP echo reply message as the description.

[0027]

[Embodiment of the Invention] Below, the gestalt of operation of the network system concerning this invention and network connection equipment is explained at a detail based on a drawing. In addition, this invention is not limited by the gestalt of this operation.

[0028] Gestalt 1. drawing 1 of operation is drawing showing the configuration of the gestalt 1 of operation of the network connection equipment concerning this invention. In drawing 1 , 100 is network connection equipment, and 101 is the condition check section. 102 is the contact information gathering section and 103 is the contact information-interchange section. 104 is the packet transmitting section, 105 is the junction section, and 106 is a comparator. 107 is the Records Department which records contact information, and 108 is an ARP table. 173 is the packet generation section and 174 is the subnet selection section. 210 is a backbone network, 211 is a communication path to which between network connection equipment is connected, 230 is a subnet, 291 is input/output port of a subnet, and 293 is input/output port of a backbone network.

[0029] Moreover, drawing 2 is drawing showing an example of a network system which used the

network connection equipment of the gestalt 1 of operation. In drawing 2, 200 is the above-mentioned network connection equipment 100 and network connection equipment with the same configuration, 231,232,233,234 is a switching hub, 221,222,227 is a terminal unit, 223 is the ARP table of a terminal unit 221, 224 is the ARP table of a terminal unit 222, 281,282,283 is input/output port of a switching hub 231, 284,285 is input/output port of a switching hub 232, and 286,287,288,289 is input/output port of a switching hub 233.

[0030] Here, actuation of the above-mentioned network connection equipment is explained using drawing 1 and drawing 2. In addition, with the gestalt of this operation, the network connection equipments 100 and 200 take a redundant configuration, and connect a backbone network 210 and a subnet 230. moreover, network connection equipment 100 — as a standby router — network connection equipment 200 — present — business — it shall operate as a router, respectively

[0031] First, with network connection equipment 100, the condition check section 101 supervises switch-on with network connection equipment 200 via a subnet 230. It is good also as performing this monitor using ping, and good also as carrying out by the monitor of a VRRP message etc. Moreover, in the condition check section 101 of network connection equipment 100, the operating state of self-equipment is periodically transmitted to the condition check section 101 of network connection equipment 200 using the communication path 211 on a backbone network 210. or [operating as a standby router with operating state here] — or — present — business — the information which shows whether it is operating as a router is meant.

[0032] In addition, when a backbone network 210 is an ATM (Asynchronous Transfer Mode) network, VC (virtual channel) is used as an example of a communication path 211.

[0033] In this condition, when a terminal unit 221 and a terminal unit 222 perform data communication, in each terminal unit, each other IP address recognized beforehand and the mutual MAC Address learned by ARP are registered into an ARP table. In addition, drawing 3 is drawing showing an example of the entry (an IP address, MAC Address) recorded on the ARP table of a terminal unit 221 (in (a), (b) expresses the time of a failure for always [forward]), 481a is an IP address (IP_222), 481b is a MAC Address (MAC_222), 482a is an IP address (IP_222), and 482b is a MAC Address (MAC_100). Moreover, drawing 4 is drawing showing an example of the entry recorded on the ARP table of a terminal unit 222 (in (a), (b) expresses the time of a failure for always [forward]), 486a is an IP address (IP_221), 486b is a MAC Address (MAC_221), 487a is an IP address (IP_221), and 487b is a MAC Address (MAC_200).

[0034] In a switching hub 231, the ARP packet transmitted from a terminal unit 221 is received in a port 282, and it learns that the terminal unit 221 is connected to the point of a port 282 based on a transmitting agency MAC Address. Moreover, the ARP packet transmitted from a terminal unit 222 is received in a port 283, and it learns that the terminal unit 222 is connected to the point of a port 283 based on a transmitting agency MAC Address. It learns that similarly a terminal unit 221 is connected to the point of a port 284, and entering 222 is connected to the point of a port 285 in a switching hub 232, and learns that a terminal unit 221 is connected to the point of a port 286, and the terminal unit 222 is further connected to the point of a port 287 in a switching hub 233.

[0035] After learning as mentioned above, in a switching hub 231, the MAC frame addressed to the MAC Address of a terminal unit 221 is outputted from a port 282, and the MAC frame addressed to the MAC Address of a terminal unit 222 is outputted from a port 283. Drawing 5 is drawing showing the transmitting MAC frame from a terminal unit 221 to a terminal unit 222. In drawing 5, 300a is a MAC header unit, 300b is IP frame section, 301 is a destination MAC Address (MAC_222), 302 is a transmitting agency MAC Address (MAC_221), 303 is a destination IP address (IP_222), and 304 is a transmitting agency IP address (IP_221). Here, the IP address of a terminal unit 222 is set as destination IP address 303, the learned MAC Address is set as destination MAC Address 301, the IP address in the end of a local is set as transmitting agency IP address 304, the MAC Address in the end of a local is set as transmitting agency MAC Address 302, and the MAC frame is transmitted to a network after that.

[0036] And the above-mentioned MAC frame is notified to a terminal unit 222 via the ports 282

and 283 of a switching hub 231, the ports 284 and 285 of a switching hub 232, and the ports 286 and 287 of a switching hub 233 based on destination MAC Address 301.

[0037] On the other hand, when a switching hub 232 breaks down and it becomes impossible to perform junction actuation, in the condition check section 101 of network connection equipment 100, failure generating is recognized by failure of ping, un-arriving [of a VRRP message], etc., and collection of contact information is directed to the contact information gathering section 102. and the communication path 211 — going — network connection equipment 200 — receiving — self-equipment — henceforth — present — business — the purport which operates as a router is notified.

[0038] Drawing 6 is drawing showing the configuration of the contact information gathering section 102. In drawing 6 , 441 is the request transmitting section which transmits an ICMP echo request message by broadcasting, 442 is a receive section which receives an ICMP echo reply message, and 443 is the study section which learns the combination of an IP address and a MAC Address. Here, actuation of the contact information gathering section 102 in network connection equipment 100 is explained. In addition, it operates similarly about the contact information gathering section 102 in network connection equipment 200.

[0039] Moreover, drawing 7 is drawing showing an example of a MAC frame format which stores the ICMP echo request message used for contact information gathering. In drawing 7 , 451 is a MAC header unit, 452 is IP header unit, 453 is the ICMP message section, 454 is a destination MAC Address (MAC_Broadcast), 455 is a transmitting agency MAC Address (MAC_100), 456 is a destination IP address (IP_SubnetBroadcast), and 457 is a transmitting agency IP address (IP_100).

[0040] In the contact information gathering section 102 in network connection equipment 100, the ICMP echo request message generated because the request transmitting section 441 makes destination MAC Address 454 a broadcast address and makes destination IP address 456 the broadcast address to a subnet 230 is transmitted to the port 291 of a subnet 230. This message is relayed by the switching hub 231, and is notified to a terminal unit 221.

[0041] In the terminal unit 221 which received the ICMP echo request message, an ICMP echo reply message is transmitted as a response. Drawing 8 is drawing showing an example of a MAC frame format which stores the ICMP echo reply message used for contact information gathering. In drawing 8 , 461 is a MAC header unit, 462 is IP header unit, 463 is the ICMP message section, 464 is a destination MAC Address (MAC_100), 465 is a transmitting agency MAC Address (MAC_221), 466 is a destination IP address (IP_100), and 467 is a transmitting agency IP address (IP_221). Here, the ICMP echo reply message generated by setting the IP address in the end of a local as transmitting agency IP address 467, and setting the MAC Address of self-equipment as transmitting agency MAC Address 465 as a response to an ICMP echo request message is transmitted. It is received by the receive section 442 of network connection equipment 100, and this reply message is notified to the study section 443.

[0042] In the study section 443, the received reply message is scrutinized, the combination of transmitting agency IP address 467 and transmitting agency MAC Address 465 is learned, and it stores in the Records Department 107 and the ARP table 108 by making the study result into contact information.

[0043] With the network connection equipment 100 which collected contact information by the contact information gathering section 102 as mentioned above, the contact information-interchange section 103 transmits the collected IP addresses to the communication path 211 on a backbone network 210. This contact information is notified to the contact information-interchange section 103 of network connection equipment 200, and is further transmitted to the subnet selection section 174.

[0044] In the subnet selection section 174 of network connection equipment 200, based on the received contact information, the subnet 230 which holds the communication terminal 222 which may communicate with a terminal unit 221 is chosen, and the contact information concerned is further notified to the packet generation section 173.

[0045] In the packet generation section 173 of network connection equipment 200, based on the received contact information, an ARP reply packet is generated and the packet concerned is

transmitted to a subnet 230. Drawing 9 (a) is drawing showing an example of an ARP reply packet format. In drawing 9 (a), 470a is a destination MAC Address (MAC_Broadcast), 470b is a transmitting agency MAC Address (MAC_200), 470c is a source hardware address (MAC_200), 470d is a source protocol address (IP_200), 470e is a target hardware address (MAC_200), and 470f is a target protocol address (IP_221). The IP address here included in the received contact information is set as target protocol address 470f. The IP address which self-network connection equipment 200 is using in the port 292 is set as source protocol address 470d. The MAC Address which self-network connection equipment 200 is using in the port 292 is set as source hardware address 470c, target hardware address 470e, and transmitting agency MAC Address 470b. A broadcast address is set as destination MAC Address 470a, and the packet transmitting section 104 transmits the generated ARP reply packet to a subnet 230. At this time, an ARP reply packet is notified to a terminal unit 222 via a switching hub 233.

[0046] In the terminal unit 222 which received the ARP reply packet, the ARP table 224 is updated based on target protocol address 470f and target hardware address 470e which are contained in the packet concerned. Speaking concretely, updating like the entry which shows the entry shown in drawing 4 (a) to (b), for example. In addition, the above renewal actuation of an ARP table of a terminal unit 222 is general actuation of ARP specified to IETF (Internet Engineering Task Force) and RFC826. Moreover, after the completion of updating actuation, with a terminal unit 222, when transmitting an IP packet to a terminal unit 221, MAC Address 487b is set as a destination MAC Address, by the switching hub 233, a port 288 will be relayed and the received IP packet concerned will be transmitted to network connection equipment 200.

[0047] moreover, with network connection equipment 200, it has been sent from the condition check section 101 of network connection equipment 100 — “— present — business — it recognizes that the failure generated notice” of a purport which operates as a router in the subnet 230 in what the condition check section 101 receives. And in the same procedure as the above-mentioned network connection equipment 100, the contact information gathering section 102 of network connection equipment 200 collects the IP addresses of terminal units 222 and 227 as contact information, and the contact information-interchange section 103 transmits the contact information concerned to network connection equipment 100.

[0048] And with the network connection equipment 100 which received contact information, with the same procedure as the above-mentioned network connection equipment 200, the ARP reply packet shown in the ARP reply packet shown in drawing 9 (b) and (c) is generated / transmitted using the contact information-interchange section 103, the subnet selection section 174, the packet generation section 173, and the packet transmitting section 104, and the ARP table 223 of a terminal unit 221 is updated. Speaking concretely, updating like the entry which shows the entry shown in drawing 3 R> 3 (a) to (b), for example. In addition, in drawing 9 (b), 471a is a destination MAC Address (MAC_Broadcast). 471b is a transmitting agency MAC Address (MAC_100), and 471c is a source hardware address (MAC_100). 471d is a source protocol address (IP_100), and 471e is a target hardware address (MAC_100). 471f is a target protocol address (IP_222), and it sets to drawing 9 (c). 472a is a destination MAC Address (MAC_Broadcast). 472b is a transmitting agency MAC Address (MAC_100), and 472c is a source hardware address (MAC_100). 472d is a source protocol address (IP_100), 472e is a target hardware address (MAC_100), and 472f is a target protocol address (IP_227).

[0049] However, a terminal unit 221 and a terminal unit 227 do not communicate, and even when the ARP reply packet which a terminal unit 221 shows to drawing 9 (c) when there is no entry equivalent to a terminal unit 227 in the ARP table 223 of a terminal unit 221 is received, updating and an addition of the ARP table 223 are not performed.

[0050] Since MAC Address 482b is set to the destination MAC Address of the MAC frame next when a terminal unit 221 transmits an IP packet to a terminal unit 222, in a switching hub 231, a port 281 is relayed and the received MAC frame is transmitted to network connection equipment 100.

[0051] With the network connection equipment 100 which received the MAC frame, a comparator 106 compares the IP address currently used in the port 291, the destination IP address in the MAC frame concerned, and the MAC Address currently used in the port 291 and the destination

MAC Address in the MAC frame concerned, respectively. And when a MAC Address is equal and IP addresses differ, the junction section 105 relays the IP packet section in the MAC frame to network connection equipment 200.

[0052] With the network connection equipment 200 which received the IP packet, the IP packet concerned is set as the MAC frame, further, the MAC Address which corresponds by searching an ARP table based on a destination IP address is gained, the retrieval result is set as the destination MAC Address of the MAC frame, and the MAC frame generated here is relayed to a port 292. At this time, the MAC frame is notified to a terminal unit 222 via a switching hub 233. In addition, also when a terminal unit 222 transmits an IP packet to a terminal unit 221, network connection equipment 200 and network connection equipment 100 are relayed to an IP packet by the same procedure as the above, and it is notified to a terminal unit 221.

[0053] However, the IP address which each network connection equipment uses, and a MAC Address are good also as using the address which is different with each equipment, and good also as using the common address with protocols, such as VRRP. moreover, the case where the common address is used — and — present — business — while the network connection equipment which operates as a router is healthy, the network connection equipment which operates as a standby router does not communicate using the address concerned.

[0054] Thus, even when each terminal unit in a subnet 230 is divided by failure etc., it can write as the configuration which communicates via a backbone network 210, and the communication link between the distributed terminal units can be made to continue in the gestalt of this operation. Moreover, when it is the same as that of the above, the ARP reply packet which the terminal unit connected to the subnet generated with the network connection equipment connected to self is written as the configuration which rewrites an ARP table in reception and general actuation of ARP, and a communication path can be changed, without adding special processing. Moreover, in the gestalt of this operation, an ICMP echo request message is transmitted by the broadcast address at the time of contact information gathering, it writes as the configuration which collects to coincidence the ICMP echo reply messages from each terminal unit connected to the subnet, and contact information can be collected efficiently.

[0055] Gestalt 2. drawing 10 of operation is drawing showing the configuration of the gestalt 2 of operation of the network connection equipment concerning this invention. In drawing 10, 100a is network connection equipment, 101a is the condition check section, 103a is the contact information-interchange section, 174a is the subnet selection section, and 175a is the transfer packet generation section. Moreover, drawing 11 is drawing showing an example of a network system which used the network connection equipment of the gestalt 2 of operation. In drawing 11, 200a is network connection equipment with the same configuration as the above-mentioned network connection equipment 100a. In addition, about the same configuration as the gestalt 1 of the above-mentioned operation, the same sign is attached and the explanation is omitted.

[0056] Here, actuation of the above-mentioned network connection equipment is explained using drawing 10 and drawing 11. In addition, the gestalt of this operation explains only different actuation from the gestalt 1 of the above-mentioned operation. Moreover, the network connection equipments 100a and 200a take a redundant configuration, and the network system of the gestalt of this operation connects a backbone network 210 and a subnet 230. moreover, network connection equipment 100a — as a standby router — network connection equipment 200a — present — business — it shall operate as a router, respectively Moreover, each network connection equipment shall share the virtual MAC Address (henceforth referred to as MAC_V), and the IP address (it is henceforth called IP_V).

[0057] First, in network connection equipment 100a, condition check section 101a supervises switch-on with network connection equipment 200a via a subnet 230. this monitor — a VRRP message etc. — using — present — business — it carries out by receiving the periodical packet transmitted from a router. Moreover, in condition check section 101 of network connection equipment 100a, the operating state of self-equipment is periodically transmitted to condition check section 101 of network connection equipment 200a using the communication path 211 on a backbone network 210. or [operating as a standby router with operating state here] — or — present — business — the information which shows whether it is operating as a router is meant.

[0058] For example, when a switching hub 232 breaks down and it becomes impossible to perform junction actuation, in condition check section 101 of network connection equipment 100a, failure generating is recognized by un-arriving [of a VRRP message], and collection of contact information is directed to the contact information gathering section 102. and the communication path 211 — going — network connection equipment 200a — receiving — self-equipment — henceforth — present — business — the purport which operates as a router is notified.

[0059] In the contact information gathering section 102 (refer to drawing 6), with the same procedure as the case of the gestalt 1 of operation, the combination of a transmitting agency IP address and a transmitting agency MAC Address is learned, and it stores in the Records Department 107 and the ARP table 108 by making the result into contact information.

[0060] In network connection equipment 100a which collected contact information by the contact information gathering section 102 as mentioned above, transfer packet generation section 175a generates an ARP reply packet based on the contact information concerned. Drawing 12 (a) is drawing showing an example of an ARP reply packet format. In drawing 12 (a), 475a is a destination MAC Address (MAC_Broadcast), 475b is a transmitting agency MAC Address (MAC_V), 475c is a source hardware address (MAC_V), 475d is a source protocol address (IP_V), 475e is a target hardware address (MAC_V), and 475f is a target protocol address (IP_221). An ARP reply packet is generated by setting the IP address here included in the stored contact information as target protocol address 475f, setting MAC_V which is a virtual MAC Address, respectively as target hardware address 475e, source hardware address 475c, and transmitting agency MAC Address 475b, setting IP_V which is a share IP address as source protocol address 475d, and setting a broadcast address as destination MAC Address 475a.

[0061] And in contact information-interchange section 103a, contact information is transmitted to the communication path 211 of a backbone network 210 in the form of the generated ARP reply packet. The contact information on this ARP reply packet format (it is only henceforth called an ARP reply packet) is notified to contact information-interchange section 103 of network connection equipment 200a, and is further transmitted to subnet selection section 174a.

[0062] The subnet 230 which holds the communication terminal 222 which may communicate with a terminal unit 221 based on the received ARP reply packet in subnet selection section 174 of network connection equipment 200a is chosen, and the ARP reply packet concerned is further transmitted to a subnet 230 in the packet transmitting section 104. At this time, an ARP reply packet is notified to a terminal unit 222 via a switching hub 233.

[0063] In the terminal unit 222 which received the ARP reply packet, the ARP table 224 is updated based on target protocol address 475f and target hardware address 475e which are contained in the packet concerned. Drawing 13 is drawing showing an example of the entry after updating (ARP table 224), 488a is an IP address (IP_221), and 488b is a MAC Address (MAC_V).

[0064] moreover, in network connection equipment 200a, it has been sent from condition check section 101 of network connection equipment 100a a — “ — present — business — it recognizes that the failure generated notice ” of a purport which operates as a router in the subnet 230 in what condition check section 101a receives. In the same procedure as the above-mentioned network connection equipment 100a, and the contact information gathering section 102 of network connection equipment 200a The IP addresses of terminal units 222 and 227 are collected as contact information. Transfer packet generation section 175a generates the ARP reply packet shown in the ARP reply packet shown in drawing 12 (b) based on the contact information concerned, and (c). Contact information-interchange section 103a transmits contact information to network connection equipment 100a in the form of the ARP reply packet concerned. In addition, in drawing 12 (b), 476a is a destination MAC Address (MAC_Broadcast), 476b is a transmitting agency MAC Address (MAC_V), and 476c is a source hardware address (MAC_V). 476d is a source protocol address (IP_V), 476e is a target hardware address (MAC_V), 476f is a target protocol address (IP_222), and it sets to drawing 12 (c). 477a is a destination MAC Address (MAC_Broadcast). 477b is a transmitting agency MAC Address (MAC_V), and 477c is a source hardware address (MAC_V). 477d is a source protocol address (IP_V), 477e is a target

hardware address (MAC_V), and 477f is a target protocol address (IP_227).

[0065] And in the same procedure as the above-mentioned network connection equipment 200a, using contact information-interchange section 103a, subnet selection section 174a, and the packet transmitting section 104, the ARP reply packet concerned is transmitted and the ARP table of a terminal unit 221 is updated in network connection equipment 100a which received the ARP reply packet. Drawing 14 is drawing showing an example of the entry after updating (ARP table 223), 483a is an IP address (IP_222), and 483b is a MAC Address (MAC_V).

[0066] Thus, even when each terminal unit in a subnet 230 is divided by failure etc., the ARP table in each terminal unit is rewritten, it can write as the configuration which communicates via a backbone network 210, and the communication link between the distributed terminal units can be made to continue in the gestalt of this operation. Moreover, when it is the same as that of the above, the ARP reply packet which the terminal unit connected to the subnet generated with the network connection equipment connected to the divided terminal unit is written as the configuration which rewrites an ARP table in reception and general actuation of ARP, and a communication path can be changed, without adding special processing.

[0067] Gestalt 3. drawing 15 of operation is drawing showing the configuration of the gestalt 3 of operation of the network connection equipment concerning this invention. In drawing 15, 100b is network connection equipment, 501b is the ARP packet junction section, 107b is the Records Department which records contact information, 210b is a backbone network, 211b is a communication path to which between network connection equipment is connected, 230b is a subnet, 291b is input/output port linked to subnet 230b, and 293b is input/output port linked to a backbone network 210.

[0068] Moreover, drawing 16 is drawing showing the configuration of the above-mentioned ARP packet junction section 501b. In drawing 16, 518 is an ARP packet receive section, 519 is the retrieval section, 520 is the request transfer section, 521 is a backbone packet receive section, 522 is a reply packet transducer, 523 is the reply packet transmitting section, 524 is the subnet selection section, 525 is a request packet transducer, 526 is the request packet transmitting section, and 527 is the reply transfer section.

[0069] Moreover, drawing 17 is drawing showing an example of a network system which used the network connection equipment of the gestalt 3 of operation. In drawing 17, 200b is network connection equipment, and 240b and 250b are subnets. 504 is a subnet fragmentation part and 211b is a communication path to which between network connection equipment is connected. 531 is an ARP request packet transmitted from a terminal unit 221. 532 is an ARP request packet transmitted from network connection equipment 100b. 533 is an ARP request packet transmitted from network connection equipment 200b. 534 is an ARP reply packet transmitted from a terminal unit 222. 535 is an ARP reply packet transmitted from network connection equipment 200b. 536 by the ARP reply packet transmitted from network connection equipment 100b **, 291b is input/output port linked to subnet 230 of network connection equipment 100b b, and 292b is input/output port linked to subnet 230 of network connection equipment 200b b. In addition, about the same configuration as the gestalt 1 of the operation explained previously, the same sign is attached and the explanation is omitted.

[0070] Here, actuation of the above-mentioned network connection equipment is explained using drawing 15, drawing 16, and drawing 17. In addition, the gestalt of this operation explains only different actuation from the gestalt 1 of the above-mentioned operation. Moreover, the network connection equipments 100a and 100b take a redundant configuration, and the network system of the gestalt of this operation connects backbone network 210b and subnet 230b. moreover, network connection equipment 100b — as a standby router — network connection equipment 200b — present — business — as a router, it shall operate, respectively and the virtual MAC Address and the IP address shall be shared

[0071] First, in network connection equipment 100b, the condition check section 101 supervises switch-on with network connection equipment 200b via subnet 230b like the gestalt 1 of operation. And when subnet 230b is divided in the subnet fragmentation part 504 and divided like the A section of illustration, and the B section for example, in network connection equipment 100b, the condition check section 101 detects a failure and records the combination of an IP

address and a MAC Address on Records Department 107b and the ARP table 108 as contact information in the same procedure as the gestalt 1 of the operation explained previously. then, network connection equipment 100b — present — business — actuation as a router is performed.

[0072] For example, when the terminal unit 221 is not communicating with a terminal unit 222, the entry equivalent to a mutual terminal unit is not registered into the ARP table of each terminal unit, and in each terminal unit, even when the ARP reply packet transmitted from the packet transmitting section 104 is received, an entry is not added to an ARP table.

[0073] On the other hand, when a terminal unit 221 newly communicates with a terminal unit 222, in a terminal unit 221, the ARP request packet 531 is transmitted to a terminal unit 222. Drawing 18 is drawing showing an example of a format of an ARP request packet and an ARP reply packet, and especially drawing 18 (a) is drawing showing an example of the ARP request packet 531. In drawing 18 (a), 531a is a destination MAC Address, 531b is a transmitting agency MAC Address, 531c is a source hardware address, 531d is a source protocol address, 531e is a target hardware address, and 531f is a target protocol address. Here, a broadcast address (MAC_BC) is set as destination MAC Address 531a, the MAC Address (MAC_221) of a terminal unit 221 is set as transmitting agency MAC Address 531b and source hardware address 531c, the IP address (IP_221) of a terminal unit 221 is set as source protocol address 531d, and the IP address (IP_222) of a terminal unit 222 is set as target protocol address 531f.

[0074] In APR packet junction section 501 of network connection equipment 100b which received ARP request packet 531 b, the ARP packet receive section 518 extracts target protocol address 531f in the ARP request packet 531 concerned. And if the IP address is not an IP address currently used by port 291b, it will search whether there is any entry to which the retrieval section 519 corresponds to target protocol address 531f at the entry recorded on Records Department 107b. In addition, since the terminal unit 222 has connected with the B section by the side of network connection equipment 200b, a retrieval result here becomes having no applicable entry.

[0075] When there is no applicable entry, the ARP request packet 531 is transmitted to the request transfer section 520, and the ARP request packet 532 equivalent to the received ARP request packet 531 is transmitted to network connection equipment 200b in the request transfer section 520 in the retrieval section 519 through communication path 211b set up on backbone network 210b. Drawing 18 R> 8 (b) is drawing showing an example of the ARP request packet 532. In drawing 18 (b), 532a is a destination MAC Address, 532b is a transmitting agency MAC Address, 532c is a source hardware address, 532d is a source protocol address, 532e is a target hardware address, and 532f is a target protocol address. Here, a broadcast address (MAC_BC) is set as destination MAC Address 532a, the MAC Address (MAC_221) of a terminal unit 221 is set as transmitting agency MAC Address 532b and source hardware address 532c, the IP address (IP_221) of a terminal unit 221 is set as source protocol address 532d, and the IP address (IP_222) of a terminal unit 222 is set as target protocol address 532f.

[0076] In network connection equipment 200b which received the ARP request packet 532, the backbone packet receive section 521 notifies the ARP request packet 532 concerned to the subnet selection section 524. In the subnet selection section 524, target protocol address 532f is extracted from the received ARP request packet 532, and subnet 230b including the address concerned is chosen from the subnets which network connection equipment 200b holds. And the ARP request packet 532 is notified to the request packet transducer 525.

[0077] In the request packet transducer 525 of network connection equipment 200b, transmitting agency MAC Address 532b of the ARP request packet 532 and source hardware address 532c are rewritten to a virtual MAC Address (MAC_V). And in the request packet transmitting section 526, the ARP request packet 533 after rewriting is transmitted from port 292b linked to subnet 230b. Drawing 18 (c) is drawing showing an example of the ARP request packet 533. In drawing 18 (c), 533a is a destination MAC Address, 533b is a transmitting agency MAC Address, 533c is a source hardware address, 533d is a source protocol address, 533e is a target hardware address, and 533f is a target protocol address. Here, a broadcast address (MAC_BC) is set as destination MAC Address 533a, a virtual MAC Address (MAC_V) is set as transmitting agency

MAC Address533b and source hardware address 533c, the IP address (IP_221) of a terminal unit 221 is set as source protocol address 533d, and the IP address (IP_222) of a terminal unit 222 is set as target protocol address 533f.

[0078] In the terminal unit 222 which received the ARP request packet 533, the IP address of the terminal unit 221 stored in source protocol address 533d and the virtual MAC Address stored in source hardware address 533c are learned, and the study result is registered into an ARP table. And the ARP reply packet 534 is transmitted as a response to the received packet. Drawing 18 (d) is drawing showing an example of the ARP reply packet 534. In drawing 18 (d), 534a is a destination MAC Address, 534b is a transmitting agency MAC Address, 534c is a source hardware address, 534d is a source protocol address, 534e is a target hardware address, and 534f is a target protocol address. Here, the virtual MA address (MAC_V) is set as destination MAC Address534a and target hardware address 534e, the MAC Address (MAC_222) of a terminal unit 222 is set as transmitting agency MAC Address534b and source hardware address 534c, the IP address (IP_222) of a terminal unit 222 is set as source protocol address 534d, and the IP address (IP_221) of a terminal unit 221 is set as target protocol address 534f.

[0079] In APR packet junction section 501of network connection equipment 200b which received ARP reply packet 534 b, the ARP packet receive section 518 extracts target protocol address 534f in the ARP reply packet 534 concerned. And if the IP address is not an IP address currently used by port 292b, the ARP reply packet 534 will be transmitted to the reply transfer section 527. In the reply transfer section 527, the ARP reply packet 535 equivalent to the received ARP reply packet 534 is transmitted to network connection equipment 100b through communication path 211b set up on backbone network 210b. Drawing 18 (e) is drawing showing an example of the ARP reply packet 535. In drawing 18 (e), 535a is a destination MAC Address, 535b is a transmitting agency MAC Address, 535c is a source hardware address, 535d is a source protocol address, 535e is a target hardware address, and 535f is a target protocol address. Here, a virtual MAC Address (MAC_V) is set as destination MAC Address535a and target hardware address 535e, the MAC Address (MAC_222) of a terminal unit 222 is set as transmitting agency MAC Address535b and source hardware address 535c, the IP address (IP_222) of a terminal unit 222 is set as source protocol address 535d, and the IP address (IP_221) of a terminal unit 221 is set as target protocol address 535f.

[0080] In network connection equipment 100b which received the ARP reply packet 535, the backbone packet receive section 521 notifies the ARP reply packet 535 concerned to the subnet selection section 524. In the subnet selection section 524, target protocol address 535f is extracted from the received ARP reply packet 535, and subnet 230b including the address concerned is chosen from the subnets which network connection equipment 100b holds. And the ARP reply packet 535 is notified to the reply packet transducer 522.

[0081] In the reply packet transducer 522 of network connection equipment 100b, target protocol address 535f of the ARP reply packet 535 is extracted. Then, the retrieval section 519 gains the MAC Address corresponding to the target protocol address 535f concerned, and rewrites destination MAC Address535a and target hardware address 535e based on the acquisition result. Moreover, in the reply packet transducer 522, transmitting agency MAC Address 535b and source hardware address 535c are rewritten to virtual MAC Address MAC_V currently used by port 291b. And in the reply packet transmitting section 523, the ARP reply packet 536 after rewriting is transmitted from port 291b linked to subnet 230b. Drawing 18 (f) is drawing showing an example of the ARP reply packet 536. In drawing 18 R> 8 (f), 536a is a destination MAC Address, 536b is a transmitting agency MAC Address, 536c is a source hardware address, 536d is a source protocol address, 536e is a target hardware address, and 536f is a target protocol address. Here, the MAC Address (MAC_221) of a terminal unit 221 is set as destination MAC Address536a and target hardware address 536e, a virtual MAC Address (MAC_V) is set as transmitting agency MAC Address536b and source hardware address 536c, the IP address (IP_222) of a terminal unit 222 is set as source protocol address 536d, and the IP address (IP_221) of a terminal unit 221 is set as target protocol address 536f.

[0082] In the terminal unit 221 which received the ARP reply packet 536, the virtual MAC Address stored in source hardware address 536c is learned as a MAC Address corresponding to

the IP address of a terminal unit 222, and it registers with an ARP table.

[0083] Henceforth, packet transmission to a terminal unit 222 from a terminal unit 221 is performed to a virtual MAC Address, and it is the same procedure as the gestalt 1 of operation, and hooks up to the network connection equipments 100b and 200b. Moreover, also with the packet transmission to a terminal unit 221 from a terminal unit 222, since the virtual MAC Address is registered into the ARP table, it is carried out to a virtual MAC Address. Thereby, a mutual communication link is attained.

[0084] Thus, in the gestalt of this operation, even when subnet 230b is divided, each network connection equipment can write as the configuration which relays an ARP packet via a backbone network, and it can newly communicate between the divided terminal units with which the entry is not registered from the first. Moreover, in the gestalt of this operation, address solution can be performed through a backbone network also with the terminal unit set up so that it might not answer to the ICMP request message transmitted to the broadcast address. Moreover, in the terminal unit connected to the subnet, it is transmitting and receiving an ARP request packet and an ARP response packet, and since an ARP table is updated, the communication link using a backbone network is attained, without adding special processing.

[0085] Gestalt 4. drawing 19 of operation is drawing showing the configuration of the gestalt 4 of operation of the network connection equipment concerning this invention. In drawing 19, 100c is network connection equipment, 101c is the condition check section, 103c is the contact information-interchange section, 104c is the packet transmitting section, 107c is the Records Department, 174c is the subnet selection section, 175c is the transfer packet generation section, and 641c is the recovery packet generation section. In addition, about above-mentioned network connection equipment 100c, condition check section 101c, contact information-interchange section 103c, packet transmitting section 104c, Records Department 107c, subnet selection section 174c, and transfer packet generation section 175c It is premised on including the same function as the condition check section in the gestalten 1 or 2 of the operation previously explained, respectively in addition to the characteristic function in the gestalt of this operation, the contact information-interchange section, the packet transmitting section, the Records Department, the subnet selection section, and the transfer packet generation section.

[0086] Moreover, drawing 20 is drawing showing an example of a network system which used the network connection equipment of the gestalt 4 of operation. In drawing 20, 200c is network connection equipment. In addition, about the same configuration as the gestalten 1 or 2 of the operation explained previously, the same sign is attached and the explanation is omitted.

[0087] Here, actuation of the above-mentioned network connection equipment is explained using drawing 19 and drawing 20. In addition, the gestalt of this operation explains only different actuation from the gestalten 1 or 2 of the operation explained previously. Moreover, the network connection equipments 100c and 200c take a redundant configuration, and the network system of the gestalt of this operation connects a backbone network 210 and a subnet 230. moreover — the gestalt of this operation — network connection equipment 100c — as a standby router — network connection equipment 200c — present — business — as a router, it operates, respectively and is further premised on the condition that the switching hub 232 broke down. Namely, it is premised on the condition that the entry shown in the ARP table 223 of a terminal unit 221 at drawing 21 (a) was registered in the same procedure as the gestalt 2 of operation, the entry shown in the ARP table 224 of a terminal unit 222 at drawing 22 (a) was registered, the entry shown in drawing 23 was registered into Records Department 107 of network connection equipment 100c c, and the entry shown in drawing 24 was registered into Records Department 107 of network connection equipment 200c c.

[0088] However, drawing 21 is drawing showing an example of the entry recorded on the ARP table of a terminal unit 221, in the entry at the time of failure generating shown in drawing 21 (a), 625a is an IP address, 626a is [625b is a MAC Address,] an IP address in the entry of forward always shown in drawing 21 (b), and 626b is a MAC Address. Moreover, drawing 22 is drawing showing an example of the entry recorded on the ARP table of a terminal unit 222, in the entry at the time of failure generating shown in drawing 22 (a), 627a is an IP address, 628a is [627b is a MAC Address,] an IP address in the entry of forward always shown in drawing 22 (b), and 628b

is a MAC Address. Moreover, drawing 23 is the example of the entry recorded on Records Department 107 of network connection equipment 100c c, in drawing 23, 652a is an IP address and 652b is a MAC Address. Moreover, drawing 24 is the example of the entry recorded on Records Department 107 of network connection equipment 200c c, in drawing 24, 653a is an IP address and 653b is a MAC Address.

[0089] In this condition, if a switching hub 232 is recovered, in condition check section 101 of network connection equipment 100c c, the flow of ping, the VRRP message reception from network connection equipment 200c, etc. will detect failure recovery of a subnet 230, and the purport to which self-equipment operates as a standby router to network connection equipment 200c via a communication path 211 will be notified.

[0090] In network connection equipment 200c which received the above-mentioned notice, condition check section 101c notifies that to recovery packet generation section 641c. In recovery packet generation section 641c, an ARP reply packet is generated with reference to Records Department 107c of self-equipment based on an entry. Drawing 25 is drawing showing an example of an ARP reply packet format. the ARP reply packet of network connection equipment 100c shown in drawing 25 (a) — it is, 660a is a destination MAC Address, 660b is a transmitting agency MAC Address, 660c is a source hardware address, 660d is a source protocol address, 660e is a target hardware address, and 660f is a target protocol address. the ARP reply packet of network connection equipment 200c shown in drawing 25 (b) — it is, 661a is a destination MAC Address, 661b is a transmitting agency MAC Address, 661c is a source hardware address, 661d is a source protocol address, 661e is a target hardware address, and 661f is a target protocol address.

[0091] Here, as shown in drawing 25 (b), IP address 653a (IP_222) is set as target protocol address 661f. MAC Address 653b (MAC_222) is set as target hardware address 661e. The IP address (IP_V) currently used for source protocol address 661d in the port 292 is set up. The virtual MAC Address (MAC_V) currently used for source hardware address 661c and transmitting agency MAC Address 661b in the port 292 is set up, and a broadcast address (MAC_Broadcast) is set as destination MAC Address 661a.

[0092] In packet transmitting section 104 of network connection equipment 200c c, the ARP reply packet generated as mentioned above is transmitted from a port 292.

[0093] At this time, the entry of the ARP table shown in drawing 21 (a) is updated like drawing 21 (b) with the terminal unit 221 which received the ARP reply packet based on target hardware address 661e and target protocol address 661f contained in the packet concerned.

[0094] On the other hand, since network connection equipment 100c becomes a standby router, it cannot perform the communication link which used the virtual address on the subnet 230. Then, the information which network connection equipment 100c holds is transmitted to network connection equipment 200c, and an ARP reply packet is transmitted from network connection equipment 200c. Speaking concretely, by network connection equipment 100c, transfer packet generation section 175c's generating an ARP reply packet based on the entry currently recorded on Records Department 107c, if condition check section 101c detects failure recovery of a subnet 230. Here, as shown in drawing 25 (a), IP address 652a (IP_221) is set as target protocol address 660f, MAC Address 652b (MAC_221) is set as target hardware address 660e, a virtual IP address (IP_V) is set as source protocol address 660d, a virtual MAC Address (MAC_V) is set as source hardware address 660c and transmitting agency MAC Address 660b, and a broadcast address (MAC_Broadcast) is set as destination MAC Address 660a.

[0095] In contact information-interchange section 103 of network connection equipment 100c c, contact information is transmitted to network connection equipment 200c in the form of the ARP reply packet generated as mentioned above.

[0096] In network connection equipment 200c which received the above-mentioned contact information, i.e., an ARP reply packet, since subnet selection section 174c is reception from a backbone network 210 and a transmitting agency MAC Address is a virtual MAC Address of a port 292, it identifies that the destination is a subnet 230. And in packet transmitting section 104c, the packet concerned is transmitted from a port 292.

[0097] In the terminal unit 222 which received the ARP reply packet, the entry of the ARP table

shown in drawing 22 (a) is updated like drawing 22 (b) based on target hardware address 660e and target protocol address 660f contained in the packet concerned.

[0098] Thus, in the gestalt of this operation, when the failure of a subnet 230 is recovered, each terminal unit can write as the configuration which rewrites the entry of the ARP table updated by the failure in the condition (always [forward]) of a basis, and can continue the communication link between terminal units by direct assignment of a mutual MAC Address henceforth. Moreover, in the gestalt of this operation, it writes as the configuration which rewrites an ARP table by general actuation of ARP, and each terminal unit connected to the subnet 230 can choose a communication path, without adding special processing.

[0099] Gestalt 5. drawing 26 of operation is drawing showing the configuration of the gestalt 5 of operation of the network connection equipment concerning this invention. In drawing 26 , 100d is network connection equipment, 103d is the contact information-interchange section, 173d is the packet generation section, and 174d is the subnet selection section.

[0100] Moreover, drawing 27 is drawing showing an example of a network system which used the network connection equipment of the gestalt 5 of operation. In drawing 27 , 200d is network connection equipment. In addition, about the same configuration as the gestalten 1-4 of the operation explained previously, the same sign is attached and the explanation is omitted.

[0101] Here, actuation of the above-mentioned network connection equipment is explained using drawing 26 and drawing 27 . In addition, the gestalt of this operation explains only different actuation from the gestalten 1-4 of the operation explained previously. Moreover, the network system of the gestalt of this operation takes 100d of network connection equipment, and a configuration with redundant 200d, and connects a backbone network 210 and a subnet 230. moreover — the gestalt of this operation — 100d of network connection equipment — as a standby router — 200d of network connection equipment — present — business — as a router, it operates, respectively and is further premised on the condition that the switching hub 232 broke down. Namely, it is premised on the condition that the entry shown in the ARP table 223 of a terminal unit 221 at drawing 21 (a) was registered in the same procedure as the gestalt 2 of operation, the entry shown in the ARP table 224 of a terminal unit 222 at drawing 22 (a) was registered, the entry shown in drawing 23 was registered into Records Department 107of network connection equipment 100c c, and the entry shown in drawing 24 R> 4 was registered into Records Department 107of network connection equipment 200c c.

[0102] In this condition, if a switching hub 232 is recovered, by 100d of network connection equipment, the ARP reply packet shown in drawing 25 will be generated like the gestalt 4 of the above-mentioned operation, and the ARP reply packet concerned will be transmitted from a port 292. And in a terminal unit 221, the entry of the ARP table shown in drawing 21 (a) is updated like drawing 21 (b).

[0103] On the other hand, since 100d of network connection equipment serves as a standby router, it cannot perform the communication link which used the virtual address on the subnet 230. So, with 200d of network connection equipment, if condition check section 101c detects failure recovery of a subnet 230, 103d of contact information-interchange sections will generate contact information based on the entry currently recorded on Records Department 107c, and they will transmit the contact information concerned to 200d of network connection equipment. That is, with reference to the contents of the entry of drawing 23 , IP address 652a and MAC Address 652b are transmitted as contact information.

[0104] At 103d of contact information-interchange sections of 200d of network connection equipment which received contact information, the IP address included in the information concerned is transmitted to 174d of subnet selection sections, and in 174d of subnet selection sections, the subnet 230 in which the received IP address is included is chosen from the subnets which 100d of network connection equipment holds, and it notifies to 173d of packet generation sections.

[0105] In 173d of packet generation sections of 200d of network connection equipment, as shown in drawing 25 (a), an ARP reply packet is generated. And in packet transmitting section 104c, the received ARP reply packet is transmitted from a port 292.

[0106] In the terminal unit 222 which received the ARP reply packet, the entry of the ARP table

shown in drawing 22 (a) is updated like drawing 22 (b) based on target hardware address 660e and target protocol address 660f contained in the packet concerned.

[0107] Thus, while writing as contact information as the configuration which sends only the combination of an IP address and a MAC Address and acquiring the same effectiveness as the gestalt 4 of the above-mentioned operation, as compared with the case where an ARP packet is transmitted, the traffic volume of a backbone network is sharply reducible in the gestalt of this operation, further. Moreover, in the gestalt of this operation, by the case where an ARP reply packet is generated based on the entry recorded on the Records Department of self-equipment, and the case where an ARP reply packet is generated based on the contact information acquired from other network connection equipments, since processing is the same, mounting can be simplified.

[Translation done.]

* NOTICES *

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the configuration of the gestalt 1 of operation of the network connection equipment concerning this invention.

[Drawing 2] It is drawing showing an example of the network system using the network connection equipment of the gestalt 1 of operation.

[Drawing 3] It is drawing showing an example of the entry recorded on the ARP table of a terminal unit 221.

[Drawing 4] It is drawing showing an example of the entry recorded on the ARP table of a terminal unit 222.

[Drawing 5] It is drawing showing the MAC frame from a terminal unit 221 to a terminal unit 222.

[Drawing 6] It is drawing showing the configuration of the contact information gathering section 102.

[Drawing 7] It is drawing showing an example of a MAC frame format which stores an ICMP echo request message.

[Drawing 8] It is drawing showing an example of a MAC frame format which stores an ICMP echo reply message.

[Drawing 9] It is drawing showing an example of an ARP reply packet format.

[Drawing 10] It is drawing showing the configuration of the gestalt 2 of operation of the network connection equipment concerning this invention.

[Drawing 11] It is drawing showing an example of the network system using the network connection equipment of the gestalt 2 of operation.

[Drawing 12] It is drawing showing an example of an ARP reply packet format.

[Drawing 13] It is drawing showing an example of the entry after updating (ARP table 224).

[Drawing 14] It is drawing showing an example of the entry after updating (ARP table 223).

[Drawing 15] It is drawing showing the configuration of the gestalt 3 of operation of the network connection equipment concerning this invention.

[Drawing 16] It is drawing showing the configuration of ARP packet junction section 501b.

[Drawing 17] It is drawing showing an example of the network system using the network connection equipment of the gestalt 3 of operation.

[Drawing 18] It is drawing showing an example of a format of an ARP request packet and an ARP reply packet.

[Drawing 19] It is drawing showing the configuration of the gestalt 4 of operation of the network connection equipment concerning this invention.

[Drawing 20] It is drawing showing an example of the network system using the network connection equipment of the gestalt 4 of operation.

[Drawing 21] It is drawing showing an example of the entry recorded on the ARP table of a terminal unit 221.

[Drawing 22] It is drawing showing an example of the entry recorded on the ARP table of a terminal unit 222.

[Drawing 23] It is the example of the entry recorded on Records Department 107of network connection equipment 100c c.

[Drawing 24] It is the example of the entry recorded on Records Department 107 of network connection equipment 200c c.

[Drawing 25] It is drawing showing an example of an ARP reply packet format.

[Drawing 26] It is drawing showing the configuration of the gestalt 5 of operation of the network connection equipment concerning this invention.

[Drawing 27] It is drawing showing an example of the network system using the network connection equipment of the gestalt 5 of operation.

[Drawing 28] It is drawing showing the conventional structure of a system.

[Drawing 29] It is drawing showing the configuration of the network system using VRRP.

[Drawing 30] It is drawing showing the outline of an ARP reply packet format in which it is used by VRRP.

[Description of Notations]

100,100a, 100b, 100c, 100d, 200,200a, 200b, 200c, 200d Network connection equipment, 101,101a, 101c The condition check section, 102 Contact information gathering section, 103,103a, 103c, 103d The contact information-interchange section, 104,104c Packet transmitting section, The 105 junction sections, 106 A comparator, 107,107b, 107c Records Department, 108 An ARP table, 173,173d Packet generation section, 174,174a, 174c, 174d The subnet selection section, and 175a and 175c Transfer packet generation section, 210,210b A backbone network, 211,211b Communication path, 221,222,227 A terminal unit, 223,224 ARP table, 230,230b, 240b, 250b A subnet, 231,232,233,234 switching hubs, 281, 282, 283, 284, 285, 286, 287, 288,289,291,291b, 292,292b, a 293,293b port, 441 The request transmitting section, 442 A receive section, 443 Study section, 501b The ARP packet junction section, 504 Subnet fragmentation part, 518 An ARP packet receive section, 519 The retrieval section, 520 Request transfer section, 521 A backbone packet receive section, 522 Reply packet transducer, 523 The reply packet transmitting section, 524 The subnet selection section, 525 A request packet transducer, 526 The request packet transmitting section, 527 The reply transfer section, 641c Recovery packet generation section.

[Translation done.]

(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開2002-232448

(P2002-232448A)

(43) 公開日 平成14年8月16日 (2002.8.16)

(51) Int.Cl. ⁷	識別記号	F I	テーマコード(参考)
H 0 4 L 12/46		H 0 4 L 12/46	A 5 K 0 3 0
12/56	1 0 0	12/56	1 0 0 A 5 K 0 3 3

審査請求 未請求 請求項の数12 O L (全 25 頁)

(21) 出願番号 特願2001-27184(P2001-27184)

(22) 出願日 平成13年2月2日(2001.2.2)

(71) 出願人 000006013

三菱電機株式会社

東京都千代田区丸の内二丁目2番3号

(72) 発明者 高橋 克佳

東京都千代田区丸の内二丁目2番3号 三菱電機株式会社内

(72) 発明者 曾田 圭一

東京都千代田区丸の内二丁目2番3号 三菱電機株式会社内

(74) 代理人 100089118

弁理士 酒井 宏明

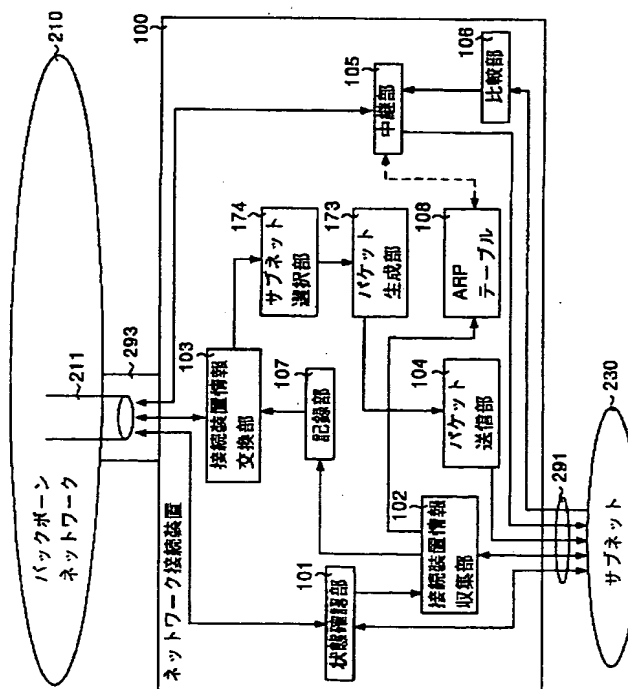
最終頁に続く

(54) 【発明の名称】 ネットワークシステムおよびネットワーク接続装置

(57) 【要約】

【課題】 故障によりサブネット内で各端末が分断された場合に、端末間の通信を継続可能なネットワーク接続装置を得ること。

【解決手段】 サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視する状態確認部101と、サブネット内の各端末装置が分断されている状態を認識した場合に自装置に接続された端末装置の接続装置情報を収集する接続装置情報収集部102と、収集した接続装置情報をバックボーンネットワーク経由で他のネットワーク接続装置と交換する接続装置情報交換部103と、受け取った接続装置情報に基づいてARPリプライパケットを生成するパケット生成部173と、ARPリプライパケットを該当するサブネットに送信するパケット送信部104と、を備える構成とする。



【特許請求の範囲】

【請求項1】 バックボーンネットワークと、複数の端末装置を収容するサブネットと、バックボーンネットワークとサブネットとを冗長接続する複数のネットワーク接続装置と、を備えたネットワークシステムにおいて、前記各ネットワーク接続装置は、サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視し、サブネット内の各端末装置が分断されている状態を認識した場合に接続装置情報の収集を指示する状態監視手段と、接続装置情報の収集指示により、同一サブネット上の全端末装置のIPアドレスとMACアドレスを接続装置情報として収集する接続装置情報収集手段と、収集した接続装置情報を、バックボーンネットワークを用いて同一サブネットに接続される他のネットワーク接続装置と交換する接続装置情報交換手段と、他のネットワーク接続装置から受け取った装置接続情報に基づいてサブネットを選択するサブネット選択手段と、前記接続装置情報に基づいてARプリバイパケットを生成し、当該ARプリバイパケットを選択されたサブネットに送信するARプリバイパケット生成/送信手段と、端末装置からIPパケットを受け取った場合に、宛先IPアドレスと自装置のもつIPアドレスとを比較する比較手段と、各IPアドレスが異なる場合に、前記IPパケットを、バックボーンネットワークを介して他のネットワーク装置に対して送信するIPパケット送信手段と、を備え、前記各端末装置は、受け取ったARプリバイパケットに基づいてARPテーブルを更新し、以降、分断された端末装置とはバックボーンネットワークを介して通信を行うことを特徴とするネットワークシステム。

【請求項2】 さらに、サブネットからARプリクエストパケットまたはARプリバイパケットを受信し、当該パケットからターゲットプロトコルアドレスを抽出するARPパケット受信手段と、前記ARPパケット受信手段がARプリクエストパケットを受信した場合に、前記収集した接続装置情報の中に当該ターゲットプロトコルアドレスに該当する情報が含まれていたかどうかを検索する第1の検索手段と、前記情報が含まれていない場合に、バックボーンネットワークに前記ARプリクエストパケットを送信するリクエスト転送手段と、前記ARPパケット受信手段がARプリバイパケットを受信した場合に、バックボーンネットワークに当該ARプリバイパケットを送信するリバイ転送手段と、バックボーンネットワークからARプリクエストパケッ

トまたはARプリバイパケットを受信するバックボーンパケット受信手段と、受信したARPパケットからターゲットプロトコルアドレスを抽出し、収容する単一または複数のサブネットの中から当該ターゲットプロトコルアドレスが含まれるサブネットを選択するサブネット選択手段と、前記バックボーンパケット受信手段がARプリクエストパケットを受信した場合に、当該パケットの送信元MACアドレスとソースハードウェアアドレスとを仮想MACアドレスに書き換えるリクエストパケット変換手段と、書き換え後のARプリクエストパケットを選択されたサブネットに送信するリクエストパケット送信手段と、前記バックボーンパケット受信手段がARプリバイパケットを受信した場合に、前記サブネット選択手段が抽出したターゲットプロトコルアドレスに基づいてMACアドレスを検索する第2の検索手段と、宛先MACアドレスおよびターゲットハードウェアアドレスを検索結果であるMACアドレスに書き換え、ソースハードウェアアドレスを仮想MACアドレスに書き換えるリバイパケット変換手段と、書き換え後のARプリバイパケットを選択されたサブネットに送信するリバイパケット送信手段と、を備えることを特徴とする請求項1に記載のネットワークシステム。

【請求項3】 バックボーンネットワークと、複数の端末装置を収容するサブネットと、バックボーンネットワークとサブネットとを冗長接続する複数のネットワーク接続装置と、を備えたネットワークシステムにおいて、前記各ネットワーク接続装置は、サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視し、サブネット内の各端末装置が分断されている状態を認識した場合に接続装置情報の収集を指示する状態監視手段と、接続装置情報の収集指示により、同一サブネット上の全端末装置のIPアドレスとMACアドレスを接続装置情報として収集する接続装置情報収集手段と、収集した接続装置情報に基づいてARプリバイパケットを生成するパケット生成手段と、生成したARプリバイパケットを、バックボーンネットワークを用いて同一サブネットに接続される他のネットワーク接続装置と交換するパケット交換手段と、他のネットワーク接続装置から受け取ったARプリバイパケットに基づいてサブネットを選択するサブネット選択手段と、前記ARプリバイパケットを選択されたサブネットに送信するARプリバイパケット送信手段と、端末装置からIPパケットを受け取った場合に、宛先IPアドレスと自装置のもつIPアドレスとを比較する比

較手段と、

各IPアドレスが異なる場合に、前記IPパケットを、バックボーンネットワークを介して他のネットワーク装置に対して送信するIPパケット送信手段と、を備え、

前記各端末装置は、受け取ったARPリプライパケットに基づいてARPテーブルを更新し、以降、分断された端末装置とはバックボーンネットワークを介して通信を行うことを特徴とするネットワークシステム。

【請求項4】 さらに、サブネットが回復した場合に、当該サブネットに接続された端末装置のARPテーブルをもとに戻すためのARPリプライパケットを生成する回復パケット生成手段、

を備え、

前記ARPリプライパケット送信手段は、前記回復パケット生成手段により生成されたARPリプライパケット、およびバックボーンネットワークから受信した、当該サブネットに接続された端末装置のARPテーブルをもとに戻すためのARPリプライパケット、をサブネットに送信し、

前記各端末装置は、受け取ったARPリプライパケットに基づいてARPテーブルをもとに戻し、以降、同一サブネット上の端末装置間ではお互いのMACアドレスを直接指定して通信を行うことを特徴とする請求項3に記載のネットワークシステム。

【請求項5】 さらに、サブネットが回復した場合に、当該サブネットに接続された端末装置のARPテーブルをもとに戻すためのARPリプライパケットを生成する第1の回復パケット生成手段と、

バックボーンネットワークから、当該サブネットに接続された端末装置のARPテーブルをもとに戻すための接続装置情報を受け取った場合に、当該接続装置情報に基づいてARPリプライパケットを生成する第2の回復パケット生成手段と、

を備え、

前記ARPリプライパケット生成/送信手段は、前記第1の回復パケット生成手段により生成されたARPリプライパケット、および第2の回復パケット生成手段により生成されたARPリプライパケット、をサブネットに送信し、

前記各端末装置は、受け取ったARPリプライパケットに基づいてARPテーブルをもとに戻し、以降、同一サブネット上の端末装置間ではお互いのMACアドレスを直接指定して通信を行うことを特徴とする請求項1に記載のネットワークシステム。

【請求項6】 前記接続装置情報収集手段は、ICMPエコーリクエストメッセージをブロードキャストアドレスで送信するリクエスト送信手段と、前記リクエストに対する応答としてICMPエコーリプライメッセージを受信する受信手段と、

前記ICMPエコーリプライメッセージに基づいてサブネット内の端末装置のIPアドレスとMACアドレスの組み合わせを学習する学習手段と、

を備えることを特徴とする請求項1～5のいずれか一つに記載のネットワークシステム。

【請求項7】 バックボーンネットワークと複数の端末装置を収容するサブネットとを冗長接続する各ネットワーク接続装置にあっては、

サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視し、サブネット内の各端末装置が分断されている状態を認識した場合に接続装置情報の収集を指示する状態監視手段と、

接続装置情報の収集指示により、同一サブネット上の全端末装置のIPアドレスとMACアドレスを接続装置情報として収集する接続装置情報収集手段と、

収集した接続装置情報を、バックボーンネットワークを用いて同一サブネットに接続される他のネットワーク接続装置と交換する接続装置情報交換手段と、

他のネットワーク接続装置から受け取った装置接続情報に基づいてサブネットを選択するサブネット選択手段と、

前記接続装置情報に基づいてARPリプライパケットを生成し、当該ARPリプライパケットを選択されたサブネットに送信するARPリプライパケット生成/送信手段と、

端末装置からIPパケットを受け取った場合に、宛先IPアドレスと自装置のもつIPアドレスとを比較する比較手段と、

各IPアドレスが異なる場合に、前記IPパケットを、バックボーンネットワークを介して他のネットワーク装置に対して送信するIPパケット送信手段と、を備えることを特徴とするネットワーク接続装置。

【請求項8】 さらに、サブネットからARPリクエストパケットまたはARPリプライパケットを受信し、当該パケットからターゲットプロトコルアドレスを抽出するARPパケット受信手段と、

前記ARPパケット受信手段がARPリクエストパケットを受信した場合に、前記収集した接続装置情報の中に当該ターゲットプロトコルアドレスに該当する情報が含まれていたかどうかを検索する第1の検索手段と、

前記情報が含まれていない場合に、バックボーンネットワークに前記ARPリクエストパケットを送信するリクエスト転送手段と、

前記ARPパケット受信手段がARPリプライパケットを受信した場合に、バックボーンネットワークに当該ARPリプライパケットを送信するリプライ転送手段と、バックボーンネットワークからARPリクエストパケットまたはARPリプライパケットを受信するバックボーンパケット受信手段と、

受信したARPパケットからターゲットプロトコルアドレスを抽出し、収容する単一または複数のサブネットの中から当該ターゲットプロトコルアドレスが含まれるサブネットを選択するサブネット選択手段と、前記バックボーンパケット受信手段がARPリクエストパケットを受信した場合に、当該パケットの送信元MACアドレスとソースハードウェアアドレスとを仮想MACアドレスに書き換えるリクエストパケット変換手段と、書き換え後のARPリクエストパケットを選択されたサブネットに送信するリクエストパケット送信手段と、前記バックボーンパケット受信手段がARPリプライパケットを受信した場合に、前記サブネット選択手段が抽出したターゲットプロトコルアドレスに基づいてMACアドレスを検索する第2の検索手段と、宛先MACアドレスおよびターゲットハードウェアアドレスを検索結果であるMACアドレスに書き換え、ソースハードウェアアドレスを仮想MACアドレスに書き換えるリプライパケット変換手段と、書き換え後のARPリプライパケットを選択されたサブネットに送信するリプライパケット送信手段と、を備えることを特徴とする請求項7に記載のネットワーク接続装置。

【請求項9】 バックボーンネットワークと複数の端末装置を収容するサブネットとを冗長接続する各ネットワーク接続装置にあっては、サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視し、サブネット内の各端末装置が分断されている状態を認識した場合に接続装置情報の収集を指示する状態監視手段と、接続装置情報の収集指示により、同一サブネット上の全端末装置のIPアドレスとMACアドレスを接続装置情報として収集する接続装置情報収集手段と、収集した接続装置情報に基づいてARPリプライパケットを生成するパケット生成手段と、生成したARPリプライパケットを、バックボーンネットワークを用いて同一サブネットに接続される他のネットワーク接続装置と交換するパケット交換手段と、他のネットワーク接続装置から受け取ったARPリプライパケットに基づいてサブネットを選択するサブネット選択手段と、前記ARPリプライパケットを選択されたサブネットに送信するARPリプライパケット送信手段と、端末装置からIPパケットを受け取った場合に、宛先IPアドレスと自装置のもつIPアドレスとを比較する比較手段と、各IPアドレスが異なる場合に、前記IPパケットを、バックボーンネットワークを介して他のネットワーク装置に対して送信するIPパケット送信手段と、

を備えることを特徴とするネットワーク接続装置。

【請求項10】 さらに、サブネットが回復した場合に、当該サブネットに接続された端末装置のARPテーブルをもとに戻すためのARPリプライパケットを生成する回復パケット生成手段、

を備え、

前記ARPリプライパケット送信手段は、前記回復パケット生成手段により生成されたARPリプライパケット、およびバックボーンネットワークから受信した、当該サブネットに接続された端末装置のARPテーブルをもとに戻すためのARPリプライパケット、をサブネットに送信することを特徴とする請求項9に記載のネットワーク接続装置。

【請求項11】 さらに、サブネットが回復した場合に、当該サブネットに接続された端末装置のARPテーブルをもとに戻すためのARPリプライパケットを生成する第1の回復パケット生成手段と、

バックボーンネットワークから、当該サブネットに接続された端末装置のARPテーブルをもとに戻すための接続装置情報を受け取った場合に、当該接続装置情報に基づいてARPリプライパケットを生成する第2の回復パケット生成手段と、

を備え、

前記ARPリプライパケット生成/送信手段は、前記第1の回復パケット生成手段により生成されたARPリプライパケット、および第2の回復パケット生成手段により生成されたARPリプライパケット、をサブネットに送信することを特徴とする請求項7に記載のネットワーク接続装置。

【請求項12】 前記接続装置情報収集手段は、

ICMPエコーリクエストメッセージをブロードキャストアドレスで送信するリクエスト送信手段と、

前記リクエストに対する応答としてICMPエコーリプライメッセージを受信する受信手段と、

前記ICMPエコーリプライメッセージに基づいてサブネット内の端末装置のIPアドレスとMACアドレスの組み合わせを学習する学習手段と、

を備えることを特徴とする請求項7～11のいずれか一つに記載のネットワーク接続装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は、バックボーンネットワークとサブネットとを冗長接続する複数のネットワーク接続装置を備えたネットワークシステムに関するものであり、特に、サブネット分断時の端末間の通信を救済可能なネットワークシステムおよびネットワーク接続装置に関するものである。

【0002】

【従来の技術】 以下、従来技術について説明する。IP (Internet Protocol) ネットワークにおいて、ルータ

によって他のネットワークと区切られたサブネットは、ルータを経由して当該サブネットの外部と通信を行う。しかしながら、ルータが故障した場合にはサブネットの外部と通信が行えなくなるため、たとえば、複数のルータを用いて通信経路の冗長化を行うことが一般的に知られている。

【0003】複数のルータを用いて通信経路の冗長化を行うシステムとしては、たとえば、特開平11-261620号公報に記載の「ルータ障害における配下LANの救済機能を有するルータネットワーク」がある。図28は、従来のシステムの構成を示す図である。図28において、10は現用ルータであり、11は代理ルータであり、12は他のルータであり、13はATMネットワークであり、14はルータが冗長化されたサブネットである。

【0004】上記公報記載の技術では、サブネット14に1つの現用ルータ10と現用ルータ10とは別の代理ルータ11とを用意する。このとき、現用ルータ10のネットワーク環境を代理ルータ11にもあらかじめ設定しておき、代理ルータ11では、pingパケット等により現用ルータ10を監視する。そして、現用ルータ10が障害となった場合には、現用ルータ10で使用していたMAC(Media Access Control)アドレスを代理ルータ11が引き継ぎ、代理ルータ11が、現用ルータ10に成り代わって動作する。具体的にいうと、現用ルータ10が障害となった場合には、代理ルータ11が、現用ルータ10にて使用している物理アドレスを引き継ぎ、サブネット外への通信フレームの中継を代行する。これにより、サブネット14と他のサブネットとの接続性を確保できる。

【0005】また、複数のルータを用いて通信経路の冗長化を行うシステムとしては、上記以外に、VRRP(Virtual Router Redundancy Protocol, Internet Engineering Task Force: IETF RFC2338)を用いたネットワークシステムがある。

【0006】VRRPでは、複数のルータが仮想ルータを構成し、仮想MACアドレスと共通のIPアドレスを共有する。現用ルータは、定期的にVRRPメッセージをサブネット内に送信することで仮想MACアドレスとIPアドレスを待機ルータに通知し、現用ルータの健在を知らしめる。一方、待機ルータは、一定時間、現用ルータからのVRRPメッセージの到着がないことをもって現用ルータの障害を検知し、仮想MACアドレスとIPアドレスを使用して代理動作を行う。

【0007】図29は、VRRPを用いたネットワークシステムの構成を示す図である。図29において、20, 21はルータであり、23, 24, 25はスイッチングハブであり、26, 27は端末装置であり、28はサブネットであり、29はバックボーンネットワークである。

【0008】また、図30は、VRRPで用いられるARP(Address Resolution Protocol)リプライパケットフォーマットの概略を示す図である。図30において、30aは宛先MACアドレス(MAC_DA)であり、30bは送信元MACアドレス(MAC_SA)であり、30cはソースハードウェアアドレス(SRC_MAC_ADDR)であり、30dはソースプロトコルアドレス(SRC_IP_ADDR)であり、30eはターゲットハードウェアアドレス(TAGT_MAC_ADDR)であり、30fはターゲットプロトコルアドレス(TAGT_IP_ADDR)である。

【0009】端末装置26および27では、デフォルトルートとして仮想MACアドレスを設定しておく、サブネット外への通信フレームを仮想MACアドレス宛に送信する。たとえば、ルータ20が現用ルータとして、ルータ21が待機ルータとして動作している場合、通信フレームは、ルータ20が中継する。

【0010】そして、現用ルータ20が故障すると、待機ルータ21では、図30に示すARPリプライパケットをサブネット28に対して送信する。すなわち、待機ルータ21では、仮想MACアドレスを送信元MACアドレス30bおよびソースハードウェアアドレス30cに格納し、共有IPアドレスをソースプロトコルアドレス30dに格納し、ブロードキャストアドレスを宛先MACアドレス30aに格納し、この状態でARPリプライパケットをサブネット28に対して送信する。

【0011】また、各スイッチングハブでは、上記ARPリプライパケットを受信および転送し、仮想MACアドレスの装置がルータ21の方向のポートにあることを学習し、以後、仮想MACアドレス宛のMACフレームをルータ21の方向に転送する。これにより、現用ルータ20が故障した場合においても、サブネット27と他のサブネットとの接続性を確保できる。

【0012】

【発明が解決しようとする課題】しかしながら、上記、複数のルータが冗長接続されたシステムでは、サブネットが分断された場合に、別々のセグメントに接続する各端末装置が物理的には他のネットワークを経由して接続されているにもかかわらず、相互の通信を行うことができなくなる、という問題があった。

【0013】たとえば、図29において、スイッチングハブ24が故障した場合は、端末装置26から端末装置27へのARPLクエストパケットが導通不能となり、通信を行うことができない。また、端末装置26のARPテーブルに端末装置27のエントリが格納されていた場合については、端末装置26が宛先MACアドレスに端末装置27のMACアドレスを設定し端末装置27へのパケットを送信するが、スイッチングハブ24の故障により当該パケットの中継が不可能となり、通信が途絶えてしまう。

【0014】本発明は、上記に鑑みてなされたものであって、サブネットと他のネットワークとが冗長接続されたシステムにおいて、たとえば、故障によりサブネット内で各端末が分断された場合においても、端末間の通信を継続可能なネットワーク接続装置を得ることを目的とする。

【0015】

【課題を解決するための手段】上述した課題を解決し、目的を達成するために、本発明にかかるネットワークシステムにあつては、バックボーンネットワークと、複数の端末装置を収容するサブネットと、バックボーンネットワークとサブネットとを冗長接続する複数のネットワーク接続装置と、を備え、前記各ネットワーク接続装置は、サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視し、サブネット内の各端末装置が分断されている状態を認識した場合に接続装置情報の収集を指示する状態監視手段（後述する実施の形態の状態確認部101に相当）と、接続装置情報の収集指示により、同一サブネット上の全端末装置のIPアドレスとMACアドレスを接続装置情報として収集する接続装置情報収集手段（接続装置情報収集部102に相当）と、収集した接続装置情報を、バックボーンネットワークを用いて同一サブネットに接続される他のネットワーク接続装置と交換する接続装置情報交換手段（接続装置情報交換部103に相当）と、他のネットワーク接続装置から受け取った装置接続情報に基づいてサブネットを選択するサブネット選択手段（サブネット選択部174に相当）と、前記接続装置情報に基づいてARPリプライパケットを生成し、当該ARPリプライパケットを選択されたサブネットに送信するARPリプライパケット生成／送信手段（パケット生成部173、パケット送信部104に相当）と、端末装置からIPパケットを受け取った場合に、宛先IPアドレスと自装置のもつIPアドレスとを比較する比較手段（比較部106に相当）と、各IPアドレスが異なる場合に、前記IPパケットを、バックボーンネットワークを介して他のネットワーク装置に対して送信するIPパケット送信手段（中継部105に相当）と、を備え、前記各端末装置は、受け取ったARPリプライパケットに基づいてARPテーブルを更新し、以降、分断された端末装置とはバックボーンネットワークを介して通信を行うことを特徴とする。

【0016】つぎの発明にかかるネットワークシステムにあつては、さらに、サブネットからARPリクエストパケットまたはARPリプライパケットを受信し、当該パケットからターゲットプロトコルアドレスを抽出するARPパケット受信手段（ARPパケット受信部518に相当）と、前記ARPパケット受信手段がARPリクエストパケットを受信した場合に、前記収集した接続装置情報の中に当該ターゲットプロトコルアドレスに該当

する情報が含まれていたかどうかを検索する第1の検索手段（検査部519に相当）と、前記情報が含まれていない場合に、バックボーンネットワークに前記ARPリクエストパケットを送信するリクエスト転送手段（リクエスト転送部520に相当）と、前記ARPパケット受信手段がARPリプライパケットを受信した場合に、バックボーンネットワークに当該ARPリプライパケットを送信するリプライ転送手段（リプライ転送部527に相当）と、バックボーンネットワークからARPリクエストパケットまたはARPリプライパケットを受信するバックボーンパケット受信手段（バックボーンパケット受信部521に相当）と、受信したARPパケットからターゲットプロトコルアドレスを抽出し、収容する単一または複数のサブネットの中から当該ターゲットプロトコルアドレスが含まれるサブネットを選択するサブネット選択手段（サブネット選択部524に相当）と、前記バックボーンパケット受信手段がARPリクエストパケットを受信した場合に、当該パケットの送信元MACアドレスとソースハードウェアアドレスとを仮想MACアドレスに書き換えるリクエストパケット変換手段（リクエストパケット変換部525に相当）と、書き換え後のARPリクエストパケットを選択されたサブネットに送信するリクエストパケット送信手段（リクエストパケット送信部526に相当）と、前記バックボーンパケット受信手段がARPリプライパケットを受信した場合に、前記サブネット選択手段が抽出したターゲットプロトコルアドレスに基づいてMACアドレスを検索する第2の検索手段（検索部519に相当）と、宛先MACアドレスおよびターゲットハードウェアアドレスを検索結果であるMACアドレスに書き換え、ソースハードウェアアドレスを仮想MACアドレスに書き換えるリプライパケット変換手段（リプライパケット変換部522に相当）と、書き換え後のARPリプライパケットを選択されたサブネットに送信するリプライパケット送信手段（リプライパケット送信部523に相当）と、を備えることを特徴とする。

【0017】つぎの発明にかかるネットワークシステムにあつては、バックボーンネットワークと、複数の端末装置を収容するサブネットと、バックボーンネットワークとサブネットとを冗長接続する複数のネットワーク接続装置と、を備え、前記各ネットワーク接続装置は、サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視し、サブネット内の各端末装置が分断されている状態を認識した場合に接続装置情報の収集を指示する状態監視手段（状態確認部101aに相当）と、接続装置情報の収集指示により、同一サブネット上の全端末装置のIPアドレスとMACアドレスを接続装置情報として収集する接続装置情報収集手段と、収集した接続装置情報に基づいてARPリプライパケットを生成す

るパケット生成手段（転送パケット生成部175aに相当）と、生成したARPLライパケットを、バックボーンネットワークを用いて同一サブネットに接続される他のネットワーク接続装置と交換するパケット交換手段（接続装置情報交換部103aに相当）と、他のネットワーク接続装置から受け取ったARPLライパケットに基づいてサブネットを選択するサブネット選択手段（サブネット選択部174aに相当）と、前記ARPLライパケットを選択されたサブネットに送信するARPLライパケット送信手段（パケット送信部104に相当）と、端末装置からIPパケットを受け取った場合に、宛先IPアドレスと自装置のもつIPアドレスとを比較する比較手段と、各IPアドレスが異なる場合に、前記IPパケットを、バックボーンネットワークを介して他のネットワーク装置に対して送信するIPパケット送信手段と、を備え、前記各端末装置は、受け取ったARPLライパケットに基づいてARPテーブルを更新し、以降、分断された端末装置とはバックボーンネットワークを介して通信を行うことを特徴とする。

【0018】つぎの発明にかかるネットワークシステムにあつては、さらに、サブネットが回復した場合に、当該サブネットに接続された端末装置のARPテーブルをもとに戻すためのARPLライパケットを生成する回復パケット生成手段（回復パケット生成部641cに相当）、を備え、前記ARPLライパケット送信手段は、前記回復パケット生成手段により生成されたARPLライパケット、およびバックボーンネットワークから受信した、当該サブネットに接続された端末装置のARPテーブルをもとに戻すためのARPLライパケット、をサブネットに送信し、前記各端末装置は、受け取ったARPLライパケットに基づいてARPテーブルをもとに戻し、以降、同一サブネット上の端末装置間ではお互いのMACアドレスを直接指定して通信を行うことを特徴とする。

【0019】つぎの発明にかかるネットワークシステムにあつては、さらに、サブネットが回復した場合に、当該サブネットに接続された端末装置のARPテーブルをもとに戻すためのARPLライパケットを生成する第1の回復パケット生成手段（回復パケット生成部641cに相当）と、バックボーンネットワークから、当該サブネットに接続された端末装置のARPテーブルをもとに戻すための接続装置情報を受け取った場合に、当該接続装置情報に基づいてARPLライパケットを生成する第2の回復パケット生成手段（パケット生成部173dに相当）と、を備え、前記ARPLライパケット生成/送信手段は、前記第1の回復パケット生成手段により生成されたARPLライパケット、および第2の回復パケット生成手段により生成されたARPLライパケット、をサブネットに送信し、前記各端末装置は、受け取ったARPLライパケットに基づいてARPテ-

ブルをもとに戻し、以降、同一サブネット上の端末装置間ではお互いのMACアドレスを直接指定して通信を行うことを特徴とする。

【0020】つぎの発明にかかるネットワークシステムにおいて、前記接続装置情報収集手段は、ICMPエコーリクエストメッセージをブロードキャストアドレスで送信するリクエスト送信手段（リクエスト送信部441に相当）と、前記リクエストに対する応答としてICMPエコーリプライメッセージを受信する受信手段（受信部442に相当）と、前記ICMPエコーリプライメッセージに基づいてサブネット内の端末装置のIPアドレスとMACアドレスの組み合わせを学習する学習手段（学習部443に相当）と、を備えることを特徴とする。

【0021】つぎの発明にかかるネットワーク接続装置にあつては、バックボーンネットワークと複数の端末装置を収容するサブネットとを冗長接続し、たとえば、サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視し、サブネット内の各端末装置が分断されている状態を認識した場合に接続装置情報の収集を指示する状態監視手段と、接続装置情報の収集指示により、同一サブネット上の全端末装置のIPアドレスとMACアドレスを接続装置情報として収集する接続装置情報収集手段と、収集した接続装置情報を、バックボーンネットワークを用いて同一サブネットに接続される他のネットワーク接続装置と交換する接続装置情報交換手段と、他のネットワーク接続装置から受け取った装置接続情報に基づいてサブネットを選択するサブネット選択手段と、前記接続装置情報に基づいてARPLライパケットを生成し、当該ARPLライパケットを選択されたサブネットに送信するARPLライパケット生成/送信手段と、端末装置からIPパケットを受け取った場合に、宛先IPアドレスと自装置のもつIPアドレスとを比較する比較手段と、各IPアドレスが異なる場合に、前記IPパケットを、バックボーンネットワークを介して他のネットワーク装置に対して送信するIPパケット送信手段と、を備えることを特徴とする。

【0022】つぎの発明にかかるネットワーク接続装置にあつては、さらに、サブネットからARPLリクエストパケットまたはARPLライパケットを受信し、当該パケットからターゲットプロトコルアドレスを抽出するARPパケット受信手段と、前記ARPパケット受信手段がARPLリクエストパケットを受信した場合に、前記収集した接続装置情報の中に当該ターゲットプロトコルアドレスに該当する情報が含まれていたかどうかを検索する第1の検索手段と、前記情報が含まれていない場合に、バックボーンネットワークに前記ARPLリクエストパケットを送信するリクエスト転送手段と、前記ARPパケット受信手段がARPLライパケットを受信した

場合に、バックボーンネットワークに当該ARPリプライパケットを送信するリプライ転送手段と、バックボーンネットワークからARPリクエストパケットまたはARPリプライパケットを受信するバックボーンパケット受信手段と、受信したARPパケットからターゲットプロトコルアドレスを抽出し、収容する単一または複数のサブネットの中から当該ターゲットプロトコルアドレスが含まれるサブネットを選択するサブネット選択手段と、前記バックボーンパケット受信手段がARPリクエストパケットを受信した場合に、当該パケットの送信元MACアドレスとソースハードウェアアドレスとを仮想MACアドレスに書き換えるリクエストパケット変換手段と、書き換え後のARPリクエストパケットを選択されたサブネットに送信するリクエストパケット送信手段と、前記バックボーンパケット受信手段がARPリプライパケットを受信した場合に、前記サブネット選択手段が抽出したターゲットプロトコルアドレスに基づいてMACアドレスを検索する第2の検索手段と、宛先MACアドレスおよびターゲットハードウェアアドレスを検索結果であるMACアドレスに書き換え、ソースハードウェアアドレスを仮想MACアドレスに書き換えるリプライパケット変換手段と、書き換え後のARPリプライパケットを選択されたサブネットに送信するリプライパケット送信手段と、を備えることを特徴とする。

【0023】つぎの発明にかかるネットワーク接続装置にあつては、バックボーンネットワークと複数の端末装置を収容するサブネットとを冗長接続し、たとえば、サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視し、サブネット内の各端末装置が分断されている状態を認識した場合に接続装置情報の収集を指示する状態監視手段と、接続装置情報の収集指示により、同一サブネット上の全端末装置のIPアドレスとMACアドレスを接続装置情報として収集する接続装置情報収集手段と、収集した接続装置情報に基づいてARPリプライパケットを生成するパケット生成手段と、生成したARPリプライパケットを、バックボーンネットワークを用いて同一サブネットに接続される他のネットワーク接続装置と交換するパケット交換手段と、他のネットワーク接続装置から受け取ったARPリプライパケットに基づいてサブネットを選択するサブネット選択手段と、前記ARPリプライパケットを選択されたサブネットに送信するARPリプライパケット送信手段と、端末装置からIPパケットを受け取った場合に、宛先IPアドレスと自装置のもつIPアドレスとを比較する比較手段と、各IPアドレスが異なる場合に、前記IPパケットを、バックボーンネットワークを介して他のネットワーク装置に対して送信するIPパケット送信手段と、を備えることを特徴とする。

【0024】つぎの発明にかかるネットワーク接続装置

にあつては、さらに、サブネットが回復した場合に、当該サブネットに接続された端末装置のARPテーブルをもとに戻すためのARPリプライパケットを生成する回復パケット生成手段、を備え、前記ARPリプライパケット送信手段は、前記回復パケット生成手段により生成されたARPリプライパケット、およびバックボーンネットワークから受信した、当該サブネットに接続された端末装置のARPテーブルをもとに戻すためのARPリプライパケット、をサブネットに送信することを特徴とする。

【0025】つぎの発明にかかるネットワーク接続装置にあつては、さらに、サブネットが回復した場合に、当該サブネットに接続された端末装置のARPテーブルをもとに戻すためのARPリプライパケットを生成する第1の回復パケット生成手段と、バックボーンネットワークから、当該サブネットに接続された端末装置のARPテーブルをもとに戻すための接続装置情報を受け取った場合に、当該接続装置情報に基づいてARPリプライパケットを生成する第2の回復パケット生成手段と、を備え、前記ARPリプライパケット生成/送信手段は、前記第1の回復パケット生成手段により生成されたARPリプライパケット、および第2の回復パケット生成手段により生成されたARPリプライパケット、をサブネットに送信することを特徴とする。

【0026】つぎの発明にかかるネットワーク接続装置において、前記接続装置情報収集手段は、ICMPエコーリクエストメッセージをブロードキャストアドレスで送信するリクエスト送信手段と、前記リクエストに対する応答としてICMPエコーリプライメッセージを受信する受信手段と、前記ICMPエコーリプライメッセージに基づいてサブネット内の端末装置のIPアドレスとMACアドレスの組み合わせを学習する学習手段と、を備えることを特徴とする。

【0027】

【発明の実施の形態】以下に、本発明にかかるネットワークシステムおよびネットワーク接続装置の実施の形態を図面に基づいて詳細に説明する。なお、この実施の形態によりこの発明が限定されるものではない。

【0028】実施の形態1. 図1は、本発明にかかるネットワーク接続装置の実施の形態1の構成を示す図である。図1において、100はネットワーク接続装置であり、101は状態確認部であり、102は接続装置情報収集部であり、103は接続装置情報交換部であり、104はパケット送信部であり、105は中継部であり、106は比較部であり、107は接続装置情報を記録する記録部であり、108はARPテーブルであり、173はパケット生成部であり、174はサブネット選択部であり、210はバックボーンネットワークであり、211はネットワーク接続装置間を結ぶ通信バスであり、230はサブネットであり、291はサブネットの入出

カポートであり、293はバックボーンネットワークの入出力ポートである。

【0029】また、図2は、実施の形態1のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。図2において、200は上記ネットワーク接続装置100と同様の構成を持つネットワーク接続装置であり、231、232、233、234はスイッチングハブであり、221、222、227は端末装置であり、223は端末装置221のARPテーブルであり、224は端末装置222のARPテーブルであり、281、282、283はスイッチングハブ231の入出力ポートであり、284、285はスイッチングハブ232の入出力ポートであり、286、287、288、289はスイッチングハブ233の入出力ポートである。

【0030】ここで、図1および図2を用いて上記ネットワーク接続装置の動作を説明する。なお、本実施の形態では、ネットワーク接続装置100と200が冗長な構成をとり、バックボーンネットワーク210とサブネット230とを接続する。また、ネットワーク接続装置100が待機ルータとして、ネットワーク接続装置200が現用ルータとして、それぞれ動作しているものとする。

【0031】まず、ネットワーク接続装置100では、状態確認部101が、サブネット230を経由してネットワーク接続装置200との導通状態を監視する。この監視は、pingを用いて行うこととしてもよいし、VRRPメッセージ等の監視により行うこととしてもよい。また、ネットワーク接続装置100の状態確認部101では、バックボーンネットワーク210上の通信パス211を用い、ネットワーク接続装置200の状態確認部101に対して定期的に自装置の動作状態を送信する。ここでいう動作状態とは、待機ルータとして動作しているか、または現用ルータとして動作しているか、を示す情報を意味する。

【0032】なお、バックボーンネットワーク210がATM (Asynchronous Transfer Mode) ネットワークの場合には、通信パス211の一例として、VC (virtual channel) を利用する。

【0033】この状態で、端末装置221と端末装置222がデータ通信を行う場合、各端末装置では、あらかじめ認識しているお互いのIPアドレスと、ARPにより学習した互いのMACアドレスと、をARPテーブルに登録する。なお、図3は、端末装置221のARPテーブルに登録されるエントリ (IPアドレス、MACアドレス) の一例を示す図であり (a) は正常時を (b) は障害時を表す)、481aはIPアドレス (IP_222) であり、481bはMACアドレス (MAC_222) であり、482aはIPアドレス (IP_222) であり、482bはMACアドレス (MAC_100) である。また、図4は、端末装置222のAR

Pテーブルに登録されるエントリの一例を示す図であり ((a) は正常時を (b) は障害時を表す)、486aはIPアドレス (IP_221) であり、486bはMACアドレス (MAC_221) であり、487aはIPアドレス (IP_221) であり、487bはMACアドレス (MAC_200) である。

【0034】スイッチングハブ231では、端末装置221から送信されるARPパケットをポート282で受信し、送信元MACアドレスに基づいて、端末装置221がポート282の先に接続されていることを学習する。また、端末装置222から送信されるARPパケットをポート283で受信し、送信元MACアドレスに基づいて、端末装置222がポート283の先に接続されていることを学習する。同様に、スイッチングハブ232においては、端末装置221がポート284の先に接続され、端末装置222がポート285の先に接続されていることを学習し、さらに、スイッチングハブ233においては、端末装置221がポート286の先に接続され、端末装置222がポート287の先に接続されていることを学習する。

【0035】上記のように学習した後は、スイッチングハブ231では、端末装置221のMACアドレス宛のMACフレームをポート282から出力し、端末装置222のMACアドレス宛のMACフレームをポート283から出力する。図5は、端末装置221から端末装置222への送信MACフレームを示す図である。図5において、300aはMACヘッダ部であり、300bはIPフレーム部であり、301は宛先MACアドレス (MAC_222) であり、302は送信元MACアドレス (MAC_221) であり、303は宛先IPアドレス (IP_222) であり、304は送信元IPアドレス (IP_221) である。ここでは、端末装置222のIPアドレスを宛先IPアドレス303に設定し、学習したMACアドレスを宛先MACアドレス301に設定し、自端末のIPアドレスを送信元IPアドレス304に設定し、自端末のMACアドレスを送信元MACアドレス302に設定し、その後、MACフレームをネットワークへ送信する。

【0036】そして、上記MACフレームは、宛先MACアドレス301に基づいて、スイッチングハブ231のポート282および283、スイッチングハブ232のポート284および285、スイッチングハブ233のポート286および287、を経由して端末装置222に通知される。

【0037】一方、スイッチングハブ232が故障し、中継動作を行えなくなった場合、ネットワーク接続装置100の状態確認部101では、pingの失敗やVRRPメッセージの未到着などにより障害発生を認識し、接続装置情報収集部102に対して接続装置情報の収集を指示する。そして、通信パス211を経由して、ネッ

トワーク接続装置200に対して、自装置が、以後、現用ルータとして動作する旨を通知する。

【0038】図6は、接続装置情報収集部102の構成を示す図である。図6において、441はICMPエコーリクエストメッセージをブロードキャストで送信するリクエスト送信部であり、442はICMPエコーリプライメッセージを受信する受信部であり、443はIPアドレスとMACアドレスとの組み合わせを学習する学習部である。ここでは、ネットワーク接続装置100内の接続装置情報収集部102の動作について説明する。なお、ネットワーク接続装置200内の接続装置情報収集部102についても同様に動作する。

【0039】また、図7は、接続装置情報収集のために用いられるICMPエコーリクエストメッセージを格納するMACフレームフォーマットの一例を示す図である。図7において、451はMACヘッダ部であり、452はIPヘッダ部であり、453はICMPメッセージ部であり、454は宛先MACアドレス(MAC_Broadcast)であり、455は送信元MACアドレス(MAC_100)であり、456は宛先IPアドレス(IP_SubnetBroadcast)であり、457は送信元IPアドレス(IP_100)である。

【0040】ネットワーク接続装置100内の接続装置情報収集部102では、リクエスト送信部441が、宛先MACアドレス454をブロードキャストアドレスとし、宛先IPアドレス456をサブネット230へのブロードキャストアドレスとすることで生成したICMPエコーリクエストメッセージを、サブネット230のポート291に送信する。このメッセージは、スイッチングハブ231で中継され、端末装置221に通知される。

【0041】ICMPエコーリクエストメッセージを受け取った端末装置221では、応答として、ICMPエコーリプライメッセージを送信する。図8は、接続装置情報収集のために用いられるICMPエコーリプライメッセージを格納するMACフレームフォーマットの一例を示す図である。図8において、461はMACヘッダ部であり、462はIPヘッダ部であり、463はICMPメッセージ部であり、464は宛先MACアドレス(MAC_100)であり、465は送信元MACアドレス(MAC_221)であり、466は宛先IPアドレス(IP_100)であり、467は送信元IPアドレス(IP_221)である。ここでは、ICMPエコーリクエストメッセージに対する応答として、送信元IPアドレス467に自端末のIPアドレスを設定し、送信元MACアドレス465に自装置のMACアドレスを設定することで生成したICMPエコーリプライメッセージを送信する。このリプライメッセージは、ネットワーク接続装置100の受信部442により受信され、学

習部443に通知される。

【0042】学習部443では、受け取ったリプライメッセージを精査し、送信元IPアドレス467と送信元MACアドレス465の組み合わせを学習し、その学習結果を接続装置情報として記録部107およびARPテーブル108に格納する。

【0043】上記のように接続装置情報収集部102により接続装置情報を収集したネットワーク接続装置100では、接続装置情報交換部103が、収集したIPアドレスをバックボーンネットワーク210上の通信パス211に送信する。この接続装置情報は、ネットワーク接続装置200の接続装置情報交換部103に通知され、さらに、サブネット選択部174に転送される。

【0044】ネットワーク接続装置200のサブネット選択部174では、受け取った接続装置情報に基づいて、端末装置221と通信を行う可能性のある通信端末222を収容するサブネット230を選択し、さらに、当該接続装置情報をパケット生成部173に対して通知する。

【0045】ネットワーク接続装置200のパケット生成部173では、受け取った接続装置情報に基づいて、ARPリプライパケットを生成し、当該パケットをサブネット230に送信する。図9(a)は、ARPリプライパケットフォーマットの一例を示す図である。図9(a)において、470aは宛先MACアドレス(MAC_Broadcast)であり、470bは送信元MACアドレス(MAC_200)であり、470cはソースハードウェアアドレス(MAC_200)であり、470dはソースプロトコルアドレス(IP_200)であり、470eはターゲットハードウェアアドレス(MAC_200)であり、470fはターゲットプロトコルアドレス(IP_221)である。ここでは、受け取った接続装置情報に含まれるIPアドレスをターゲットプロトコルアドレス470fに設定し、自ネットワーク接続装置200がポート292で使用しているIPアドレスをソースプロトコルアドレス470dに設定し、自ネットワーク接続装置200がポート292で使用しているMACアドレスをソースハードウェアアドレス470cとターゲットハードウェアアドレス470eと送信元MACアドレス470bに設定し、ブロードキャストアドレスを宛先MACアドレス470aに設定し、パケット送信部104が、生成されたARPリプライパケットをサブネット230に送信する。このとき、ARPリプライパケットは、スイッチングハブ233を経由して端末装置222に通知される。

【0046】ARPリプライパケットを受け取った端末装置222では、当該パケットに含まれるターゲットプロトコルアドレス470fとターゲットハードウェアアドレス470eに基づいて、ARPテーブル224を更新する。具体的にいうと、たとえば、図4(a)に示す

エントリを(b)に示すエントリのように更新する。なお、上記のような端末装置222のARPテーブル更新動作は、IETF (Internet Engineering Task Force), RFC 826に規定されたARPの一般的な動作である。また、更新動作完了後、端末装置222では、端末装置221に対してIPパケットを送信する場合、宛先MACアドレスにMACアドレス487bを設定し、スイッチングハブ233では、受け取った当該IPパケットを、ポート288を中継してネットワーク接続装置200に対して送信することになる。

【0047】また、ネットワーク接続装置200では、ネットワーク接続装置100の状態確認部101から送られてきた「現用ルータとして動作する旨の通知」を、状態確認部101が受け取ることで、サブネット230に障害が発生したことを認識する。そして、上記ネットワーク接続装置100と同様の手順で、ネットワーク接続装置200の接続装置情報収集部102が、端末装置222および227のIPアドレスを接続装置情報として収集し、接続装置情報交換部103が、当該接続装置情報をネットワーク接続装置100に対して送信する。

【0048】そして、接続装置情報を受け取ったネットワーク接続装置100では、上記ネットワーク接続装置200と同様の手順で、接続装置情報交換部103、サブネット選択部174、パケット生成部173、およびパケット送信部104を用いて、図9(b)に示すARプリパケットおよび(c)に示すARプリパケットを生成/送信し、端末装置221のARPテーブル223を更新する。具体的にいうと、たとえば、図3(a)に示すエントリを(b)に示すエントリのように更新する。なお、図9(b)において、471aは宛先MACアドレス(MAC_Broadcast)であり、471bは送信元MACアドレス(MAC_100)であり、471cはソースハードウェアアドレス(MAC_100)であり、471dはソースプロトコルアドレス(IP_100)であり、471eはターゲットハードウェアアドレス(MAC_100)であり、471fはターゲットプロトコルアドレス(IP_222)であり、図9(c)において、472aは宛先MACアドレス(MAC_Broadcast)であり、472bは送信元MACアドレス(MAC_100)であり、472cはソースハードウェアアドレス(MAC_100)であり、472dはソースプロトコルアドレス(IP_100)であり、472eはターゲットハードウェアアドレス(MAC_100)であり、472fはターゲットプロトコルアドレス(IP_227)である。

【0049】ただし、端末装置221と端末装置227が通信を行っておらず、端末装置221のARPテーブル223に端末装置227に相当するエントリがない場合には、端末装置221が図9(c)に示すARプリ

パケットを受信した場合でも、ARPテーブル223の更新および追加は行われない。

【0050】つぎに、端末装置221が端末装置222に対してIPパケットを送信する場合、MACフレームの宛先MACアドレスにはMACアドレス482bが設定されるため、スイッチングハブ231では、受け取ったMACフレームを、ポート281を中継してネットワーク接続装置100に対して送信する。

【0051】MACフレームを受け取ったネットワーク接続装置100では、比較部106が、ポート291で使用しているIPアドレスと当該MACフレーム中の宛先IPアドレス、およびポート291で使用しているMACアドレスと当該MACフレーム中の宛先MACアドレス、をそれぞれ比較する。そして、MACアドレスが等しくかつIPアドレスが異なる場合には、中継部105が、MACフレーム内のIPパケット部をネットワーク接続装置200へ中継する。

【0052】IPパケットを受け取ったネットワーク接続装置200では、当該IPパケットをMACフレームに設定し、さらに、宛先IPアドレスに基づいてARPテーブルを検索することで対応するMACアドレスを獲得し、その検索結果をMACフレームの宛先MACアドレスに設定し、ここで生成されたMACフレームをポート292へ中継する。このとき、MACフレームは、スイッチングハブ233を経由して端末装置222に通知される。なお、端末装置222が端末装置221に対してIPパケットを送信する場合も、IPパケットは、上記と同様の手順でネットワーク接続装置200およびネットワーク接続装置100を中継され、端末装置221へ通知される。

【0053】ただし、各ネットワーク接続装置が使用するIPアドレスとMACアドレスは、それぞれの装置で異なるアドレスを用いることとしてもよいし、VRRP等のプロトコルにより共通のアドレスを用いることとしてもよい。また、共通のアドレスを用いる場合で、かつ現用ルータとして動作するネットワーク接続装置が健全である間、待機ルータとして動作するネットワーク接続装置は、当該アドレスを用いて通信を行わない。

【0054】このように、本実施の形態においては、故障等によりサブネット230内の各端末装置が分断された場合でも、バックボーンネットワーク210を経由して通信を行う構成としたため、分散された端末装置間の通信を継続させることができる。また、上記と同様の場合に、サブネットに接続された端末装置が、自身に接続されたネットワーク接続装置にて生成したARプリパケットを受け取り、ARPの一般的な動作でARPテーブルを書き換える構成としたため、特別な処理を追加することなく通信経路を変更できる。また、本実施の形態においては、接続装置情報収集時に、ICMPエコーリクエストメッセージをブロードキャストアドレスで

送信し、サブネットに接続されている各端末装置からのICMPエコーリプライメッセージを同時に収集する構成としたため、効率良く接続装置情報を収集できる。

【0055】実施の形態2。図10は、本発明にかかるネットワーク接続装置の実施の形態2の構成を示す図である。図10において、100aはネットワーク接続装置であり、101aは状態確認部であり、103aは接続装置情報交換部であり、174aはサブネット選択部であり、175aは転送パケット生成部である。また、図11は、実施の形態2のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。図11において、200aは上記ネットワーク接続装置100aと同様の構成を持つネットワーク接続装置である。なお、前述の実施の形態1と同様の構成については、同一の符号を付してその説明を省略する。

【0056】ここで、図10および図11を用いて上記ネットワーク接続装置の動作を説明する。なお、本実施の形態では、前述の実施の形態1と異なる動作についてのみ説明する。また、本実施の形態のネットワークシステムは、ネットワーク接続装置100aと200aが冗長な構成をとり、バックボーンネットワーク210とサブネット230とを接続する。また、ネットワーク接続装置100aが待機ルータとして、ネットワーク接続装置200aが現用ルータとして、それぞれ動作しているものとする。また、各ネットワーク接続装置は、仮想MACアドレス（以後、MAC_Vと呼ぶ）とIPアドレス（以後、IP_Vと呼ぶ）とを共有しているものとする。

【0057】まず、ネットワーク接続装置100aでは、状態確認部101aが、サブネット230を経由してネットワーク接続装置200aとの導通状態を監視する。この監視は、VRRPメッセージ等を用い、現用ルータから送信される定期的なパケットを受信することで行う。また、ネットワーク接続装置100aの状態確認部101aでは、バックボーンネットワーク210上の通信パス211を用い、ネットワーク接続装置200aの状態確認部101aに対して定期的に自装置の動作状態を送信する。ここでいう動作状態とは、待機ルータとして動作しているか、または現用ルータとして動作しているか、を示す情報を意味する。

【0058】たとえば、スイッチングハブ232が故障し、中継動作を行えなくなった場合、ネットワーク接続装置100aの状態確認部101aでは、VRRPメッセージの未到着により障害発生を認識し、接続装置情報収集部102に対して接続装置情報の収集を指示する。そして、通信パス211を経由してネットワーク接続装置200aに対して、自装置が、以後、現用ルータとして動作する旨を通知する。

【0059】接続装置情報収集部102（図6参照）では、実施の形態1の場合と同様の手順で、送信元IPア

ドレスと送信元MACアドレスの組み合わせを学習し、その結果を接続装置情報として記録部107およびARPテーブル108に格納する。

【0060】上記のように接続装置情報収集部102により接続装置情報を収集したネットワーク接続装置100aでは、転送パケット生成部175aが、当該接続装置情報に基づいてARプリプライパケットを生成する。図12(a)は、ARプリプライパケットフォーマットの一例を示す図である。図12(a)において、475aは宛先MACアドレス(MAC_Broadcast)であり、475bは送信元MACアドレス(MAC_V)であり、475cはソースハードウェアアドレス(MAC_V)であり、475dはソースプロトコルアドレス(IP_V)であり、475eはターゲットハードウェアアドレス(MAC_V)であり、475fはターゲットプロトコルアドレス(IP_221)である。ここでは、格納された接続装置情報に含まれるIPアドレスをターゲットプロトコルアドレス475fに設定し、仮想MACアドレスであるMAC_Vをターゲットハードウェアアドレス475e、ソースハードウェアアドレス475cおよび送信元MACアドレス475bにそれぞれ設定し、共有IPアドレスであるIP_Vをソースプロトコルアドレス475dに設定し、ブロードキャストアドレスを宛先MACアドレス475aに設定することで、ARプリプライパケットを生成する。

【0061】そして、接続装置情報交換部103aでは、生成されたARプリプライパケットの形式で接続装置情報をバックボーンネットワーク210の通信パス211に送信する。このARプリプライパケット形式の接続装置情報（以降、単にARプリプライパケットと呼ぶ）は、ネットワーク接続装置200aの接続装置情報交換部103aに通知され、さらに、サブネット選択部174aに転送される。

【0062】ネットワーク接続装置200aのサブネット選択部174aでは、受け取ったARプリプライパケットに基づいて、端末装置221と通信を行う可能性のある通信端末222を収容するサブネット230を選択し、さらに、パケット送信部104では、当該ARプリプライパケットをサブネット230に送信する。このとき、ARプリプライパケットは、スイッチングハブ233を経由して端末装置222に通知される。

【0063】ARプリプライパケットを受け取った端末装置222では、当該パケットに含まれるターゲットプロトコルアドレス475fとターゲットハードウェアアドレス475eに基づいて、ARPテーブル224を更新する。図13は、更新後のエントリ（ARPテーブル224）の一例を示す図であり、488aはIPアドレス(IP_221)であり、488bはMACアドレス(MAC_V)である。

【0064】また、ネットワーク接続装置200aで

は、ネットワーク接続装置100aの状態確認部101aから送られてきた「現用ルータとして動作する旨の通知」を、状態確認部101aが受け取ることで、サブネットワーク230に障害が発生したことを認識する。そして、上記ネットワーク接続装置100aと同様の手順で、ネットワーク接続装置200aの接続装置情報収集部102が、端末装置222および227のIPアドレスを接続装置情報として収集し、転送パケット生成部175aが、当該接続装置情報に基づいて図12(b)に示すARPLリプライパケットおよび(c)に示すARPLリプライパケットを生成し、接続装置情報交換部103aが、当該ARPLリプライパケットの形式で接続装置情報をネットワーク接続装置100aに対して送信する。なお、図12(b)において、476aは宛先MACアドレス(MAC_Broadcast)であり、476bは送信元MACアドレス(MAC_V)であり、476cはソースハードウェアアドレス(MAC_V)であり、476dはソースプロトコルアドレス(IP_V)であり、476eはターゲットハードウェアアドレス(MAC_V)であり、476fはターゲットプロトコルアドレス(IP_222)であり、図12(c)において、477aは宛先MACアドレス(MAC_Broadcast)であり、477bは送信元MACアドレス(MAC_V)であり、477cはソースハードウェアアドレス(MAC_V)であり、477dはソースプロトコルアドレス(IP_V)であり、477eはターゲットハードウェアアドレス(MAC_V)であり、477fはターゲットプロトコルアドレス(IP_227)である。

【0065】そして、ARPLリプライパケットを受け取ったネットワーク接続装置100aでは、上記ネットワーク接続装置200aと同様の手順で、接続装置情報交換部103a、サブネット選択部174aおよびパケット送信部104を用いて、当該ARPLリプライパケットを送信し、端末装置221のARPテーブルを更新する。図14は、更新後のエントリ(ARPテーブル223)の一例を示す図であり、483aはIPアドレス(IP_222)であり、483bはMACアドレス(MAC_V)である。

【0066】このように、本実施の形態においては、故障等によりサブネットワーク230内の各端末装置が分断された場合でも、各端末装置内のARPテーブルを書き換え、バックボーンネットワーク210を経由して通信を行う構成としたため、分散された端末装置間の通信を継続させることができる。また、上記と同様の場合に、サブネットワークに接続された端末装置が、分断された端末装置に接続されたネットワーク接続装置にて生成したARPLリプライパケットを受け取り、ARPの一般的な動作でARPテーブルを書き換える構成としたため、特別な処理を追加することなく通信経路を変更できる。

【0067】実施の形態3. 図15は、本発明にかかるネットワーク接続装置の実施の形態3の構成を示す図である。図15において、100bはネットワーク接続装置であり、501bはARPパケット中継部であり、107bは接続装置情報を記録する記録部であり、210bはバックボーンネットワークであり、211bはネットワーク接続装置間を結ぶ通信パスであり、230bはサブネットワークであり、291bはサブネットワーク230bに接続する入出力ポートであり、293bはバックボーンネットワーク210に接続する入出力ポートである。

【0068】また、図16は、上記ARPパケット中継部501bの構成を示す図である。図16において、518はARPパケット受信部であり、519は検索部であり、520はリクエスト転送部であり、521はバックボーンパケット受信部であり、522はリプライパケット変換部であり、523はリプライパケット送信部であり、524はサブネット選択部であり、525はリクエストパケット変換部であり、526はリクエストパケット送信部であり、527はリプライ転送部である。

【0069】また、図17は、実施の形態3のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。図17において、200bはネットワーク接続装置であり、240b、250bはサブネットワークであり、504はサブネットワーク分断箇所であり、211bはネットワーク接続装置間を結ぶ通信パスであり、531は端末装置221から送信されるARPLリクエストパケットであり、532はネットワーク接続装置100bから送信されるARPLリクエストパケットであり、533はネットワーク接続装置200bから送信されるARPLリクエストパケットであり、534は端末装置222から送信されるARPLリプライパケットであり、535はネットワーク接続装置200bから送信されるARPLリプライパケットであり、536はネットワーク接続装置100bから送信されるARPLリプライパケットであり、291bはネットワーク接続装置100bのサブネットワーク230bに接続する入出力ポートであり、292bはネットワーク接続装置200bのサブネットワーク230bに接続する入出力ポートである。なお、先に説明した実施の形態1と同様の構成については、同一の符号を付してその説明を省略する。

【0070】ここで、図15、図16および図17を用いて、上記ネットワーク接続装置の動作を説明する。なお、本実施の形態では、前述の実施の形態1と異なる動作についてのみ説明する。また、本実施の形態のネットワークシステムは、ネットワーク接続装置100aと100bが冗長な構成をとり、バックボーンネットワーク210bとサブネットワーク230bとを接続する。また、ネットワーク接続装置100bが待機ルータとして、ネットワーク接続装置200bが現用ルータとして、それぞれ動作しているものとし、仮想MACアドレスとIPア

ドレスとを共有しているものとする。

【0071】まず、ネットワーク接続装置100bでは、状態確認部101が、実施の形態1と同様に、サブネット230bを経由してネットワーク接続装置200bとの導通状態を監視する。そして、たとえば、サブネット230bがサブネット分断箇所504で分断され、図示のA部とB部のように分断された場合、ネットワーク接続装置100bでは、状態確認部101が障害を検知し、先に説明した実施の形態1と同様の手順で、記録部107bおよびARPテーブル108に、IPアドレスとMACアドレスの組み合わせを接続装置情報として記録する。その後、ネットワーク接続装置100bは、現用ルータとしての動作を行う。

【0072】たとえば、端末装置221が端末装置22と通信を行っていない場合、各端末装置のARPテーブルには互いの端末装置に相当するエントリが登録されておらず、各端末装置では、パケット送信部104から送信されたARプリプライパケットを受信した場合でも、ARPテーブルにエントリを追加しない。

【0073】一方、端末装置221が新たに端末装置22と通信を行う場合、端末装置221では、端末装置222に対してARプリクエストパケット531を送信する。図18は、ARプリクエストパケットおよびARプリプライパケットのフォーマットの一例を示す図であり、特に、図18(a)は、ARプリクエストパケット531の一例を示す図である。図18(a)において、531aは宛先MACアドレスであり、531bは送信元MACアドレスであり、531cはソースハードウェアアドレスであり、531dはソースプロトコルアドレスであり、531eはターゲットハードウェアアドレスであり、531fはターゲットプロトコルアドレスである。ここでは、宛先MACアドレス531aにブロードキャストアドレス(MAC_BC)を設定し、送信元MACアドレス531bおよびソースハードウェアアドレス531cに端末装置221のMACアドレス(MAC_221)を設定し、ソースプロトコルアドレス531dに端末装置221のIPアドレス(IP_221)を設定し、ターゲットプロトコルアドレス531fに端末装置222のIPアドレス(IP_222)を設定する。

【0074】ARプリクエストパケット531を受け取ったネットワーク接続装置100bのAPRパケット中継部501bでは、ARPパケット受信部518が、当該ARプリクエストパケット531中のターゲットプロトコルアドレス531fを抽出する。そして、そのIPアドレスがポート291bで使用しているIPアドレスでなければ、検索部519が、記録部107bに記録されたエントリに、ターゲットプロトコルアドレス531fに該当するエントリがあるかどうかを検索する。なお、端末装置222がネットワーク接続装置200b側

のB部に接続しているため、ここでの検索結果は該当エントリ無しとなる。

【0075】該当エントリが無い場合、検索部519では、リクエスト転送部520にARプリクエストパケット531を転送し、リクエスト転送部520では、受け取ったARプリクエストパケット531に相当するARプリクエストパケット532を、バックボーンネットワーク210b上に設定された通信パス211bを介してネットワーク接続装置200bに対して送信する。図18(b)は、ARプリクエストパケット532の一例を示す図である。図18(b)において、532aは宛先MACアドレスであり、532bは送信元MACアドレスであり、532cはソースハードウェアアドレスであり、532dはソースプロトコルアドレスであり、532eはターゲットハードウェアアドレスであり、532fはターゲットプロトコルアドレスである。ここでは、宛先MACアドレス532aにブロードキャストアドレス(MAC_BC)を設定し、送信元MACアドレス532bおよびソースハードウェアアドレス532cに端末装置221のMACアドレス(MAC_221)を設定し、ソースプロトコルアドレス532dに端末装置221のIPアドレス(IP_221)を設定し、ターゲットプロトコルアドレス532fに端末装置222のIPアドレス(IP_222)を設定する。

【0076】ARプリクエストパケット532を受け取ったネットワーク接続装置200bでは、バックボーンパケット受信部521が、サブネット選択部524に対して当該ARプリクエストパケット532を通知する。サブネット選択部524では、受け取ったARプリクエストパケット532からターゲットプロトコルアドレス532fを抽出し、ネットワーク接続装置200bの收容するサブネットのなかから当該アドレスを含むサブネット230bを選択する。そして、リクエストパケット変換部525に対してARプリクエストパケット532を通知する。

【0077】ネットワーク接続装置200bのリクエストパケット変換部525では、ARプリクエストパケット532の送信元MACアドレス532bとソースハードウェアアドレス532cとを仮想MACアドレス(MAC_V)に書き換える。そして、リクエストパケット送信部526では、書き換え後のARプリクエストパケット533をサブネット230bに接続するポート292bから送信する。図18(c)は、ARプリクエストパケット533の一例を示す図である。図18(c)において、533aは宛先MACアドレスであり、533bは送信元MACアドレスであり、533cはソースハードウェアアドレスであり、533dはソースプロトコルアドレスであり、533eはターゲットハードウェアアドレスであり、533fはターゲットプロトコルアドレスである。ここでは、宛先MACアドレス533aに

ブロードキャストアドレス (MAC_BC) を設定し、送信元MACアドレス533bおよびソースハードウェアアドレス533cに仮想MACアドレス (MAC_V) を設定し、ソースプロトコルアドレス533dに端末装置221のIPアドレス (IP_221) を設定し、ターゲットプロトコルアドレス533fに端末装置222のIPアドレス (IP_222) を設定する。

【0078】ARPリクエストパケット533を受け取った端末装置222では、ソースプロトコルアドレス533dに格納された端末装置221のIPアドレスと、ソースハードウェアアドレス533cに格納された仮想MACアドレスと、を学習し、その学習結果をARPテーブルに登録する。そして、受け取ったパケットに対する応答として、ARPリプライパケット534を送信する。図18(d)は、ARPリプライパケット534の一例を示す図である。図18(d)において、534aは宛先MACアドレスであり、534bは送信元MACアドレスであり、534cはソースハードウェアアドレスであり、534dはソースプロトコルアドレスであり、534eはターゲットハードウェアアドレスであり、534fはターゲットプロトコルアドレスである。ここでは、宛先MACアドレス534aおよびターゲットハードウェアアドレス534eに仮想MACアドレス (MAC_V) を設定し、送信元MACアドレス534bおよびソースハードウェアアドレス534cに端末装置222のMACアドレス (MAC_222) を設定し、ソースプロトコルアドレス534dに端末装置222のIPアドレス (IP_222) を設定し、ターゲットプロトコルアドレス534fに端末装置221のIPアドレス (IP_221) を設定する。

【0079】ARPリプライパケット534を受け取ったネットワーク接続装置200bのAPRパケット中継部501bでは、ARPパケット受信部518が、当該ARPリプライパケット534中のターゲットプロトコルアドレス534fを抽出する。そして、そのIPアドレスがポート292bで使用しているIPアドレスでなければ、リプライ転送部527に対してARPリプライパケット534を転送する。リプライ転送部527では、受け取ったARPリプライパケット534に相当するARPリプライパケット535を、バックボーンネットワーク210b上に設定された通信パス211bを介してネットワーク接続装置100bに対して送信する。図18(e)は、ARPリプライパケット535の一例を示す図である。図18(e)において、535aは宛先MACアドレスであり、535bは送信元MACアドレスであり、535cはソースハードウェアアドレスであり、535dはソースプロトコルアドレスであり、535eはターゲットハードウェアアドレスであり、535fはターゲットプロトコルアドレスである。ここでは、宛先MACアドレス535aおよびターゲットハー

ドウェアアドレス535eに仮想MACアドレス (MAC_V) を設定し、送信元MACアドレス535bおよびソースハードウェアアドレス535cに端末装置222のMACアドレス (MAC_222) を設定し、ソースプロトコルアドレス535dに端末装置222のIPアドレス (IP_222) を設定し、ターゲットプロトコルアドレス535fに端末装置221のIPアドレス (IP_221) を設定する。

【0080】ARPリプライパケット535を受け取ったネットワーク接続装置100bでは、バックボーンパケット受信部521が、サブネット選択部524に対して当該ARPリプライパケット535を通知する。サブネット選択部524では、受け取ったARPリプライパケット535からターゲットプロトコルアドレス535fを抽出し、ネットワーク接続装置100bの収容するサブネットのなかから当該アドレスを含むサブネット230bを選択する。そして、リプライパケット変換部522に対してARPリプライパケット535を通知する。

【0081】ネットワーク接続装置100bのリプライパケット変換部522では、ARPリプライパケット535のターゲットプロトコルアドレス535fを抽出する。その後、検索部519が、当該ターゲットプロトコルアドレス535fに対応するMACアドレスを獲得し、その獲得結果に基づいて宛先MACアドレス535aおよびターゲットハードウェアアドレス535eを書き換える。また、リプライパケット変換部522では、送信元MACアドレス535bとソースハードウェアアドレス535cとを、ポート291bで使用している仮想MACアドレスMAC_Vに書き換える。そして、リプライパケット送信部523では、書き換え後のARPリプライパケット536をサブネット230bに接続するポート291bから送信する。図18(f)は、ARPリプライパケット536の一例を示す図である。図18(f)において、536aは宛先MACアドレスであり、536bは送信元MACアドレスであり、536cはソースハードウェアアドレスであり、536dはソースプロトコルアドレスであり、536eはターゲットハードウェアアドレスであり、536fはターゲットプロトコルアドレスである。ここでは、宛先MACアドレス536aおよびターゲットハードウェアアドレス536eに端末装置221のMACアドレス (MAC_221) を設定し、送信元MACアドレス536bおよびソースハードウェアアドレス536cに仮想MACアドレス (MAC_V) を設定し、ソースプロトコルアドレス536dに端末装置222のIPアドレス (IP_222) を設定し、ターゲットプロトコルアドレス536fに端末装置221のIPアドレス (IP_221) を設定する。

【0082】ARPリプライパケット536を受け取っ

た端末装置221では、端末装置222のIPアドレスに対応するMACアドレスとして、ソースハードウェアアドレス536cに格納された仮想MACアドレスを学習し、ARPテーブルに登録する。

【0083】以降、端末装置221から端末装置222へのパケット送信は、仮想MACアドレス宛に行われ、実施の形態1と同様の手順で、ネットワーク接続装置100bおよび200bに中継される。また、端末装置222から端末装置221へのパケット送信についても、ARPテーブルに仮想MACアドレスが登録されているため、仮想MACアドレス宛に行われる。これにより、相互の通信が可能となる。

【0084】このように、本実施の形態においては、サブネット230bが分断された場合でも、各ネットワーク接続装置がバックボーンネットワークを経由してARPパケットを中継する構成としたため、もともとエントリが登録されていない分断された端末装置間においても新たに通信を行うことができる。また、本実施の形態においては、ブロードキャストアドレス宛に送信されたICMPリクエストメッセージに対して応答しないように設定された端末装置についても、バックボーンネットワークを介してアドレス解決を行うことができる。また、サブネットに接続された端末装置においては、ARPLリクエストパケットおよびARPLレスポンスパケットを送受信することで、ARPテーブルを更新するため、特別な処理を追加することなくバックボーンネットワークを用いた通信が可能となる。

【0085】実施の形態4。図19は、本発明にかかるネットワーク接続装置の実施の形態4の構成を示す図である。図19において、100cはネットワーク接続装置であり、101cは状態確認部であり、103cは接続装置情報交換部であり、104cはパケット送信部であり、107cは記録部であり、174cはサブネット選択部であり、175cは転送パケット生成部であり、641cは回復パケット生成部である。なお、上記ネットワーク接続装置100c、状態確認部101c、接続装置情報交換部103c、パケット送信部104c、記録部107c、サブネット選択部174c、転送パケット生成部175cについては、本実施の形態における特徴的な機能以外に、それぞれ先に説明した実施の形態1または2における状態確認部、接続装置情報交換部、パケット送信部、記録部、サブネット選択部、転送パケット生成部と同様の機能を含むことを前提とする。

【0086】また、図20は、実施の形態4のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。図20において、200cはネットワーク接続装置である。なお、先に説明した実施の形態1または2と同様の構成については、同一の符号を付してその説明を省略する。

【0087】ここで、図19および図20を用いて上記

ネットワーク接続装置の動作を説明する。なお、本実施の形態では、先に説明した実施の形態1または2と異なる動作についてのみ説明する。また、本実施の形態のネットワークシステムは、ネットワーク接続装置100cと200cが冗長な構成をとり、バックボーンネットワーク210とサブネット230とを接続する。また、本実施の形態では、ネットワーク接続装置100cが待機ルータとして、ネットワーク接続装置200cが現用ルータとして、それぞれ動作し、さらに、スイッチングハブ232が故障した状態を前提とする。すなわち、実施の形態2と同様の手順で、端末装置221のARPテーブル223に図21(a)に示すエントリが登録され、端末装置222のARPテーブル224に図22(a)に示すエントリが登録され、ネットワーク接続装置100cの記録部107cに図23に示すエントリが登録され、ネットワーク接続装置200cの記録部107cに図24に示すエントリが登録された状態を前提とする。

【0088】ただし、図21は、端末装置221のARPテーブルに登録されるエントリの一例を示す図であり、図21(a)に示す障害発生時のエントリにおいて、625aはIPアドレスであり、625bはMACアドレスであり、図21(b)に示す正常時のエントリにおいて、626aはIPアドレスであり、626bはMACアドレスである。また、図22は、端末装置222のARPテーブルに登録されるエントリの一例を示す図であり、図22(a)に示す障害発生時のエントリにおいて、627aはIPアドレスであり、627bはMACアドレスであり、図22(b)に示す正常時のエントリにおいて、628aはIPアドレスであり、628bはMACアドレスである。また、図23は、ネットワーク接続装置100cの記録部107cに登録されるエントリの例であり、図23において、652aはIPアドレスであり、652bはMACアドレスである。また、図24は、ネットワーク接続装置200cの記録部107cに登録されるエントリの例であり、図24において、653aはIPアドレスであり、653bはMACアドレスである。

【0089】この状態で、スイッチングハブ232が回復すると、ネットワーク接続装置100cの状態確認部101cでは、pingの導通やネットワーク接続装置200cからのVRRPメッセージ受信などによりサブネット230の障害回復を検出し、通信パス211を経由してネットワーク接続装置200cに対して自装置が待機ルータとして動作する旨を通知する。

【0090】上記通知を受け取ったネットワーク接続装置200cでは、状態確認部101cが、その旨を回復パケット生成部641cに通知する。回復パケット生成部641cでは、自装置の記録部107cを参照し、エントリに基づいてARPLリプライパケットを生成する。図25は、ARPLリプライパケットフォーマットの一例

を示す図である。図25(a)に示すネットワーク接続装置100cのARプリバイパケットにおいて、660aは宛先MACアドレスであり、660bは送信元MACアドレスであり、660cはソースハードウェアアドレスであり、660dはソースプロトコルアドレスであり、660eはターゲットハードウェアアドレスであり、660fはターゲットプロトコルアドレスである。図25(b)に示すネットワーク接続装置200cのARプリバイパケットにおいて、661aは宛先MACアドレスであり、661bは送信元MACアドレスであり、661cはソースハードウェアアドレスであり、661dはソースプロトコルアドレスであり、661eはターゲットハードウェアアドレスであり、661fはターゲットプロトコルアドレスである。

【0091】ここでは、図25(b)に示すように、ターゲットプロトコルアドレス661fにIPアドレス653a(IP_222)を設定し、ターゲットハードウェアアドレス661eにMACアドレス653b(MAC_222)を設定し、ソースプロトコルアドレス661dにポート292で使用しているIPアドレス(IP_V)を設定し、ソースハードウェアアドレス661cと送信元MACアドレス661bにポート292で使用している仮想MACアドレス(MAC_V)を設定し、宛先MACアドレス661aにブロードキャストアドレス(MAC_Broadcast)を設定する。

【0092】ネットワーク接続装置200cのパケット送信部104cでは、上記のように生成したARプリバイパケットをポート292から送信する。

【0093】このとき、ARプリバイパケットを受け取った端末装置221では、当該パケットに含まれるターゲットハードウェアアドレス661eとターゲットプロトコルアドレス661fに基づいて、図21(a)に示すARPテーブルのエントリを図21(b)のように更新する。

【0094】一方、ネットワーク接続装置100cは、待機ルータとなるのでサブネット230上で仮想アドレスを使用した通信ができない。そこで、ネットワーク接続装置100cの保有する情報をネットワーク接続装置200cに転送し、ネットワーク接続装置200cからARプリバイパケットを送信する。具体的にいうと、ネットワーク接続装置100cでは、状態確認部101cがサブネット230の障害回復を検出すると、転送パケット生成部175cが、記録部107cに記録されているエントリに基づいてARプリバイパケットを生成する。ここでは、図25(a)に示すように、ターゲットプロトコルアドレス660fにIPアドレス652a(IP_221)を設定し、ターゲットハードウェアアドレス660eにMACアドレス652b(MAC_221)を設定し、ソースプロトコルアドレス660dに仮想IPアドレス(IP_V)を設定し、ソースハード

ウェアアドレス660cと送信元MACアドレス660bに仮想MACアドレス(MAC_V)を設定し、宛先MACアドレス660aにブロードキャストアドレス(MAC_Broadcast)を設定する。

【0095】ネットワーク接続装置100cの接続装置情報交換部103cでは、上記のように生成したARプリバイパケットの形式で接続装置情報をネットワーク接続装置200cに対して送信する。

【0096】上記接続装置情報、すなわち、ARプリバイパケットを受け取ったネットワーク接続装置200cでは、サブネット選択部174cが、バックボーンネットワーク210からの受信でありかつ送信元MACアドレスがポート292の仮想MACアドレスであることから、宛先がサブネット230であることを識別する。そして、パケット送信部104cでは、当該パケットをポート292から送信する。

【0097】ARプリバイパケットを受け取った端末装置222では、当該パケットに含まれるターゲットハードウェアアドレス660eとターゲットプロトコルアドレス660fに基づいて、図22(a)に示すARPテーブルのエントリを図22(b)のように更新する。

【0098】このように、本実施の形態においては、サブネット230の障害が回復した場合に、各端末装置が、障害により更新されたARPテーブルのエントリをもとの状態(正常時)に書き換える構成としたため、以降、互いのMACアドレスの直接指定により、端末装置間の通信を継続することができる。また、本実施の形態においては、サブネット230に接続された各端末装置が、ARPの一般的な動作によりARPテーブルを書き換える構成としたため、特別な処理を追加することなく通信経路を選択できる。

【0099】実施の形態5。図26は、本発明にかかるネットワーク接続装置の実施の形態5の構成を示す図である。図26において、100dはネットワーク接続装置であり、103dは接続装置情報交換部であり、173dはパケット生成部であり、174dはサブネット選択部である。

【0100】また、図27は、実施の形態5のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。図27において、200dはネットワーク接続装置である。なお、先に説明した実施の形態1~4と同様の構成については、同一の符号を付してその説明を省略する。

【0101】ここで、図26および図27を用いて上記ネットワーク接続装置の動作を説明する。なお、本実施の形態では、先に説明した実施の形態1~4と異なる動作についてのみ説明する。また、本実施の形態のネットワークシステムは、ネットワーク接続装置100dと200dが冗長な構成をとり、バックボーンネットワーク210とサブネット230とを接続する。また、本実施

の形態では、ネットワーク接続装置100dが待機ルータとして、ネットワーク接続装置200dが現用ルータとして、それぞれ動作し、さらに、スイッチングハブ232が故障した状態を前提とする。すなわち、実施の形態2と同様の手順で、端末装置221のARPテーブル223に図21(a)に示すエントリが登録され、端末装置222のARPテーブル224に図22(a)に示すエントリが登録され、ネットワーク接続装置100cの記録部107cに図23に示すエントリが登録され、ネットワーク接続装置200cの記録部107cに図24に示すエントリが登録された状態を前提とする。

【0102】この状態で、スイッチングハブ232が回復すると、ネットワーク接続装置100dでは、前述の実施の形態4と同様に、図25に示すARPリプライパケットを生成し、当該ARPリプライパケットをポート292から送信する。そして、端末装置221では、図21(a)に示すARPテーブルのエントリを図21(b)のように更新する。

【0103】一方、ネットワーク接続装置100dは、待機ルータとなるのでサブネット230上で仮想アドレスを使用した通信ができない。そこで、ネットワーク接続装置200dでは、状態確認部101cがサブネット230の障害回復を検出すると、接続装置情報交換部103dが、記録部107cに記録されているエントリに基づいて接続装置情報を生成し、当該接続装置情報をネットワーク接続装置200dに対して送信する。すなわち、図23のエントリの内容を参照し、IPアドレス652aとMACアドレス652bを接続装置情報として送信する。

【0104】接続装置情報を受け取ったネットワーク接続装置200dの接続装置情報交換部103dでは、当該情報に含まれるIPアドレスをサブネット選択部174dに転送し、サブネット選択部174dでは、ネットワーク接続装置100dが収容するサブネットの中から、受け取ったIPアドレスが含まれるサブネット230を選択し、パケット生成部173dに通知する。

【0105】ネットワーク接続装置200dのパケット生成部173dでは、図25(a)に示すように、ARPリプライパケットを生成する。そして、パケット送信部104cでは、受け取ったARPリプライパケットをポート292から送信する。

【0106】ARPリプライパケットを受け取った端末装置222では、当該パケットに含まれるターゲットハードウェアアドレス660eとターゲットプロトコルアドレス660fに基づいて、図22(a)に示すARPテーブルのエントリを図22(b)のように更新する。

【0107】このように、本実施の形態においては、接続装置情報として、IPアドレスとMACアドレスの組み合わせのみを送る構成としたため、前述の実施の形態4と同様の効果が得られるとともに、さらに、ARPパ

ケットを送信する場合と比較してバックボーンネットワークのトラフィック量を大幅に削減することができる。また、本実施の形態においては、自装置の記録部に記録されたエントリに基づいてARPリプライパケットを生成する場合と、他のネットワーク接続装置から得た接続装置情報に基づいてARPリプライパケットを生成する場合で、処理が同じであるため、実装を簡単にすることができる。

【0108】

【発明の効果】以上、説明したとおり、本発明によれば、故障等によりサブネット内の各端末装置が分断された場合でも、バックボーンネットワークを経由して通信を行う構成としたため、分散された端末装置間の通信を継続させることができる、という効果を奏する。また、上記と同様の場合に、サブネットに接続された端末装置が、自身に接続されたネットワーク接続装置にて生成したARPリプライパケットを受け取り、ARPの一般的な動作でARPテーブルを書き換える構成としたため、特別な処理を追加することなく通信経路を変更することができる、という効果を奏する。

【0109】つぎの発明によれば、サブネットが分断された場合でも、各ネットワーク接続装置がバックボーンネットワークを経由してARPパケットを中継する構成としたため、もともとエントリが登録されていない分断された端末装置間においても新たに通信を行うことができる、という効果を奏する。また、ブロードキャストアドレス宛に送信されたICMPリクエストメッセージに対して応答しないように設定された端末装置についても、バックボーンネットワークを介してアドレス解決を行うことができる、という効果を奏する。また、サブネットに接続された端末装置においては、ARPリクエストパケットおよびARPレスポンスパケットを送受信することで、ARPテーブルを更新するため、特別な処理を追加することなくバックボーンネットワークを用いた通信が可能となる、という効果を奏する。

【0110】つぎの発明によれば、故障等によりサブネット内の各端末装置が分断された場合でも、各端末装置内のARPテーブルを書き換え、バックボーンネットワークを経由して通信を行う構成としたため、分散された端末装置間の通信を継続させることができる、という効果を奏する。また、上記と同様の場合に、サブネットに接続された端末装置が、分断された端末装置に接続されたネットワーク接続装置にて生成したARPリプライパケットを受け取り、ARPの一般的な動作でARPテーブルを書き換える構成としたため、特別な処理を追加することなく通信経路を変更できる、という効果を奏する。

【0111】つぎの発明によれば、サブネットの障害が回復した場合に、各端末装置が、障害により更新されたARPテーブルのエントリをもとの状態（正常時）に書

き換える構成としたため、以降、互いのMACアドレスの直接指定により、端末装置間の通信を継続することができる、という効果を奏する。また、サブネットに接続された各端末装置が、ARPの一般的な動作によりARPテーブルを書き換える構成としたため、特別な処理を追加することなく通信経路を選択できる、という効果を奏する。

【0112】つぎの発明によれば、接続装置情報として、IPアドレスとMACアドレスの組み合わせのみを送る構成としたため、さらに、ARPパケットを送信する場合と比較してバックボーンネットワークのトラヒック量を大幅に削減することができる、という効果を奏する。また、自装置で収集した接続装置情報に基づいてARPリプライパケットを生成する場合と、他のネットワーク接続装置から得た接続装置情報に基づいてARPリプライパケットを生成する場合で、処理が同じであるため、実装を簡単にすることができる、という効果を奏する。

【0113】つぎの発明によれば、接続装置情報収集時に、ICMPエコーリクエストメッセージをブロードキャストアドレスで送信し、サブネットに接続されている各端末装置からのICMPエコーリプライメッセージを同時に収集する構成としたため、効率良く接続装置情報を収集できる、という効果を奏する。

【0114】つぎの発明によれば、故障等によりサブネット内の各端末装置が分断された場合でも、バックボーンネットワークを経由して通信を行う構成としたため、分散された端末装置間の通信を継続させることができる、という効果を奏する。

【0115】つぎの発明によれば、サブネットが分断された場合でも、各ネットワーク接続装置がバックボーンネットワークを経由してARPパケットを中継する構成としたため、もともとエントリが登録されていない分断された端末装置間においても新たに通信を行うことができる、という効果を奏する。また、ブロードキャストアドレス宛に送信されたICMPリクエストメッセージに対して応答しないように設定された端末装置についても、バックボーンネットワークを介してアドレス解決を行うことができる、という効果を奏する。

【0116】つぎの発明によれば、故障等によりサブネット内の各端末装置が分断された場合でも、各端末装置内のARPテーブルを書き換え、バックボーンネットワークを経由して通信を行う構成としたため、分散された端末装置間の通信を継続させることができる、という効果を奏する。

【0117】つぎの発明によれば、サブネットの障害が回復した場合に、各端末装置が障害により更新されたARPテーブルのエントリをもとの状態（正常時）に書き換えるように制御する構成としたため、以降、互いのMACアドレスの直接指定により、端末装置間の通信を継

続することができる、という効果を奏する。

【0118】つぎの発明によれば、接続装置情報として、IPアドレスとMACアドレスの組み合わせのみを送る構成としたため、さらに、ARPパケットを送信する場合と比較してバックボーンネットワークのトラヒック量を大幅に削減することができる、という効果を奏する。また、自装置で収集した接続装置情報に基づいてARPリプライパケットを生成する場合と、他のネットワーク接続装置から得た接続装置情報に基づいてARPリプライパケットを生成する場合で、処理が同じであるため、実装を簡単にすることができる、という効果を奏する。

【0119】つぎの発明によれば、接続装置情報収集時に、ICMPエコーリクエストメッセージをブロードキャストアドレスで送信し、サブネットに接続されている各端末装置からのICMPエコーリプライメッセージを同時に収集する構成としたため、効率良く接続装置情報を収集できる、という効果を奏する。

【図面の簡単な説明】

【図1】 本発明にかかるネットワーク接続装置の実施の形態1の構成を示す図である。

【図2】 実施の形態1のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。

【図3】 端末装置221のARPテーブルに記録されるエントリの一例を示す図である。

【図4】 端末装置222のARPテーブルに記録されるエントリの一例を示す図である。

【図5】 端末装置221から端末装置222へのMACフレームを示す図である。

【図6】 接続装置情報収集部102の構成を示す図である。

【図7】 ICMPエコーリクエストメッセージを格納するMACフレームフォーマットの一例を示す図である。

【図8】 ICMPエコーリプライメッセージを格納するMACフレームフォーマットの一例を示す図である。

【図9】 ARPリプライパケットフォーマットの一例を示す図である。

【図10】 本発明にかかるネットワーク接続装置の実施の形態2の構成を示す図である。

【図11】 実施の形態2のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。

【図12】 ARPリプライパケットフォーマットの一例を示す図である。

【図13】 更新後のエントリ（ARPテーブル224）の一例を示す図である。

【図14】 更新後のエントリ（ARPテーブル223）の一例を示す図である。

【図15】 本発明にかかるネットワーク接続装置の実施の形態3の構成を示す図である。

【図16】 ARPパケット中継部501bの構成を示す図である。

【図17】 実施の形態3のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。

【図18】 ARPリクエストパケットおよびARプリプライパケットのフォーマットの一例を示す図である。

【図19】 本発明にかかるネットワーク接続装置の実施の形態4の構成を示す図である。

【図20】 実施の形態4のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。

【図21】 端末装置221のARPテーブルに記録されるエントリの一例を示す図である。

【図22】 端末装置222のARPテーブルに記録されるエントリの一例を示す図である。

【図23】 ネットワーク接続装置100cの記録部107cに記録されるエントリの例である。

【図24】 ネットワーク接続装置200cの記録部107cに記録されるエントリの例である。

【図25】 ARPリプライパケットフォーマットの一例を示す図である。

【図26】 本発明にかかるネットワーク接続装置の実施の形態5の構成を示す図である。

【図27】 実施の形態5のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。

【図28】 従来のシステムの構成を示す図である。

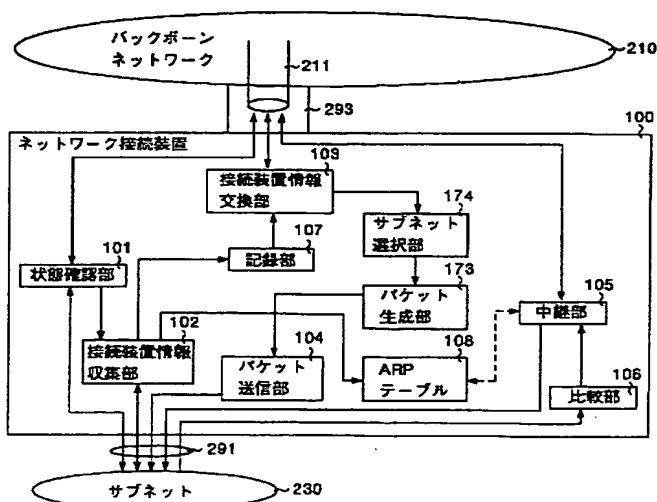
【図29】 VRRPを用いたネットワークシステムの構成を示す図である。

【図30】 VRRPで用いられるARPリプライパケットフォーマットの概略を示す図である。

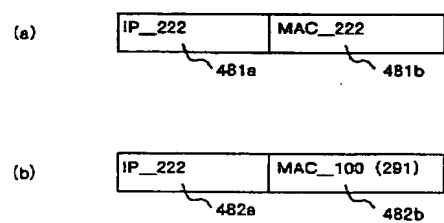
【符号の説明】

100, 100a, 100b, 100c, 100d, 200, 200a, 200b, 200c, 200d ネットワーク接続装置、101, 101a, 101c 状態確認部、102 接続装置情報収集部、103, 103a, 103c, 103d 接続装置情報交換部、104, 104c パケット送信部、105中継部、106比較部、107, 107b, 107c 記録部、108 ARPテーブル、173, 173d パケット生成部、174, 174a, 174c, 174d サブネット選択部、175a, 175c 転送パケット生成部、210, 210b バックボーンネットワーク、211, 211b 通信パス、221, 222, 227 端末装置、223, 224 ARPテーブル、230, 230b, 240b, 250b サブネット、231, 232, 233, 234スイッチングハブ、281, 282, 283, 284, 285, 286, 287, 288, 289, 291, 291b, 292, 292b, 293, 293bポート、441 リクエスト送信部、442 受信部、443 学習部、501b ARPパケット中継部、504 サブネット分断箇所、518 ARPパケット受信部、519 検索部、520 リクエスト転送部、521 バックボーンパケット受信部、522 リプライパケット変換部、523 リプライパケット送信部、524 サブネット選択部、525 リクエストパケット変換部、526 リクエストパケット送信部、527 リプライ転送部、641c 回復パケット生成部。

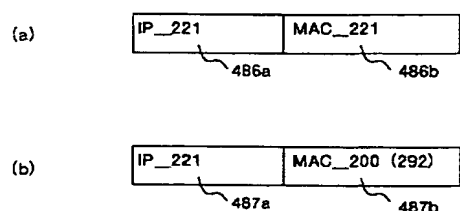
【図1】



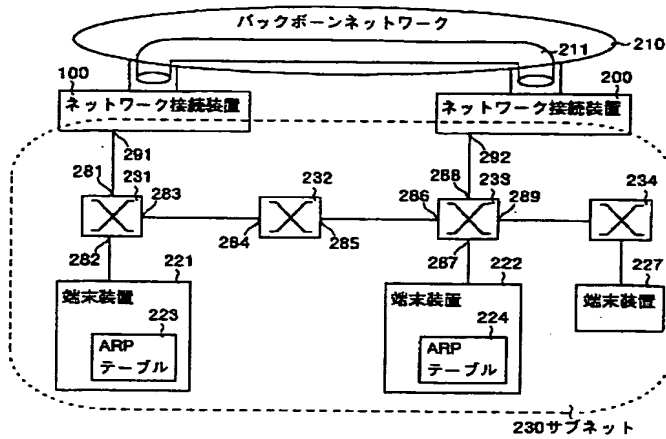
【図3】



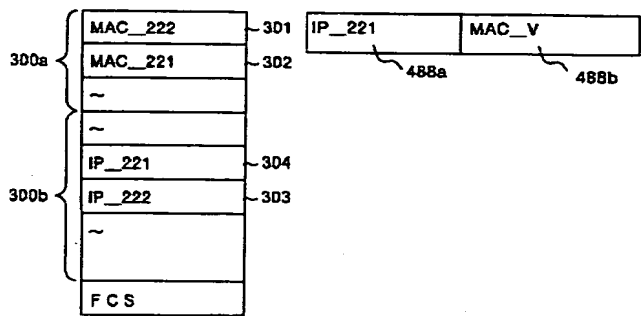
【図4】



【図2】

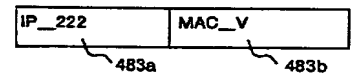


【図5】

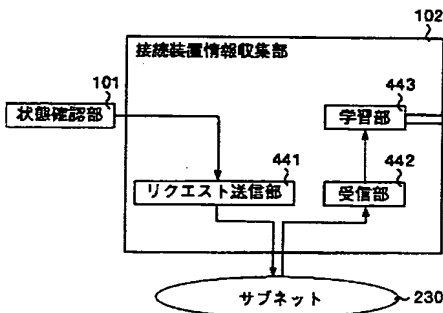


【図13】

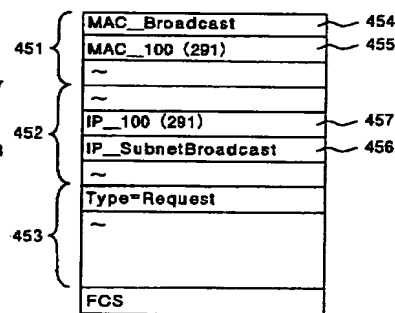
【図14】



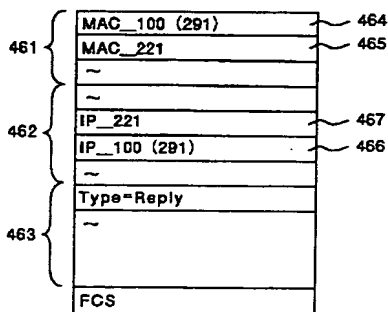
【図6】



【図7】

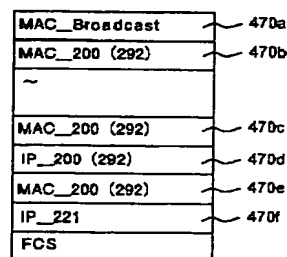


【図8】

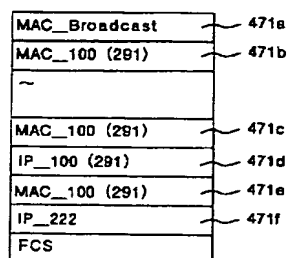


【図9】

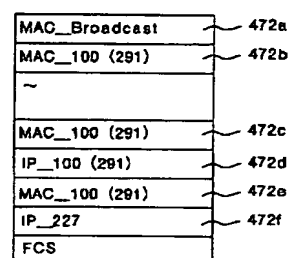
(a)



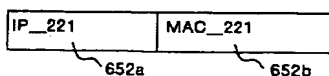
(b)



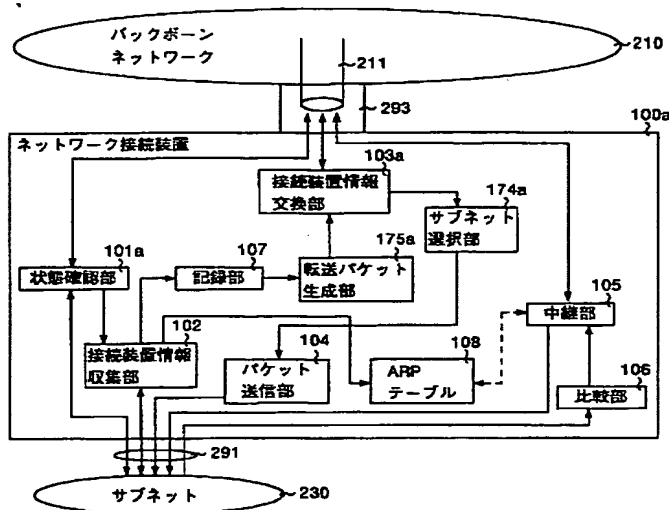
(c)



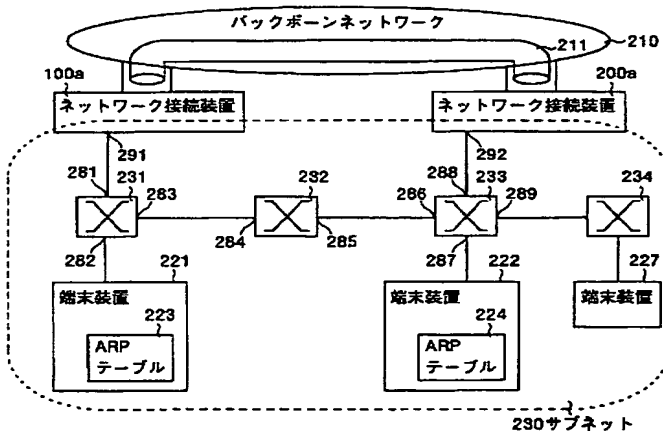
【図23】



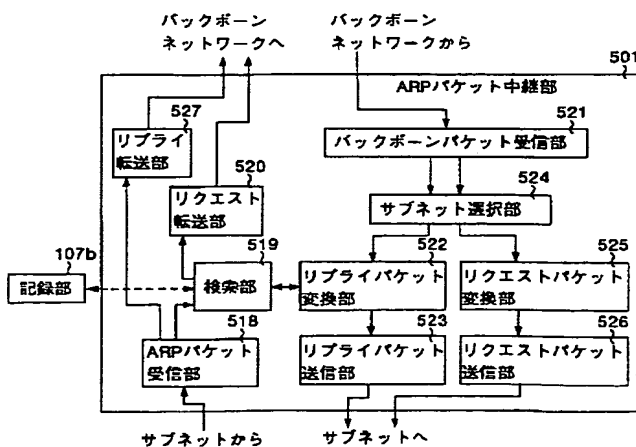
【図10】



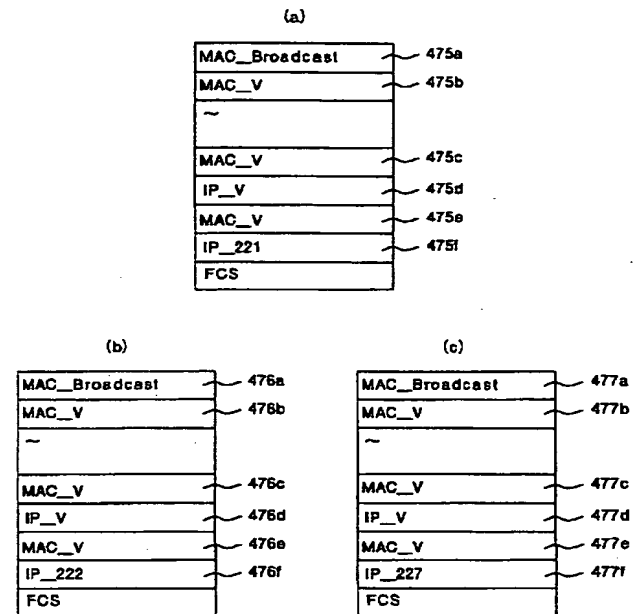
【図11】



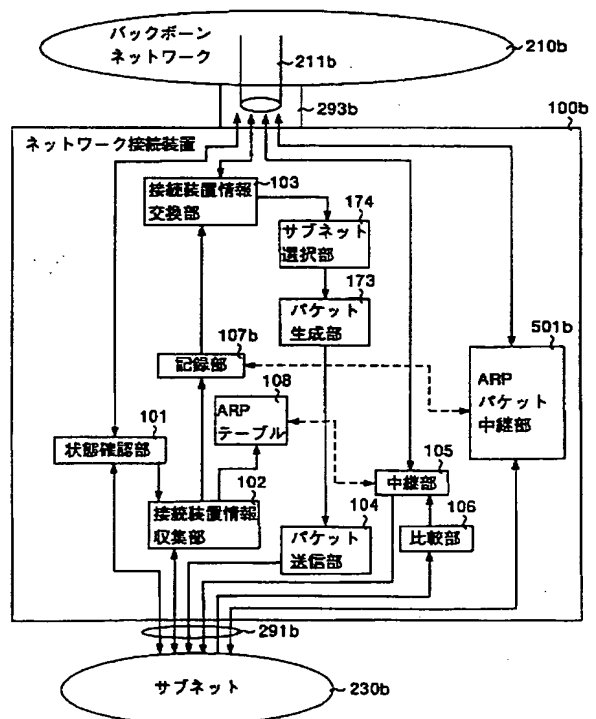
【図16】



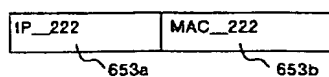
【図12】



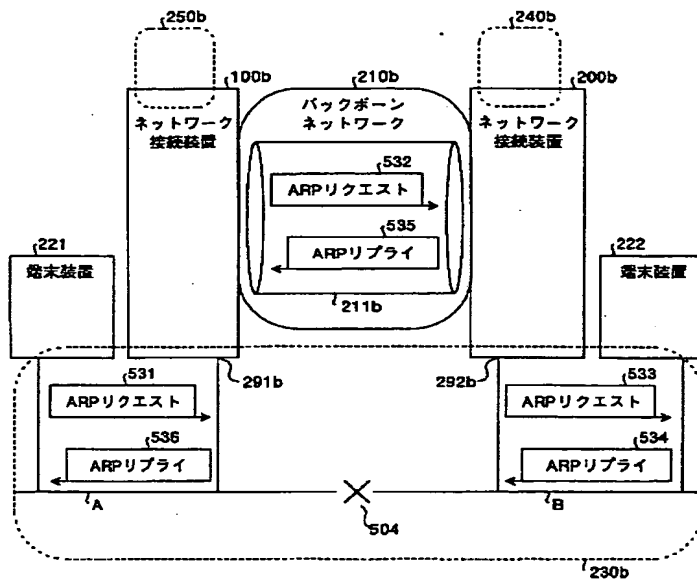
【図15】



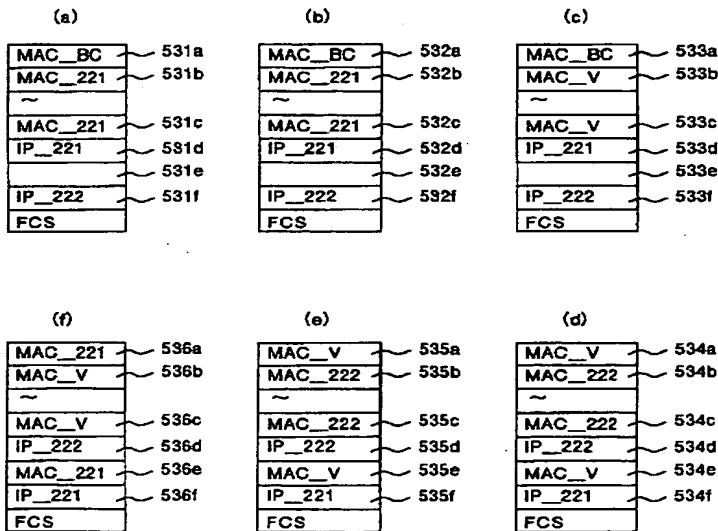
【図24】



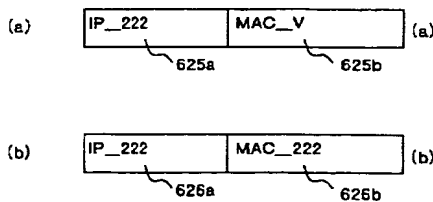
【図17】



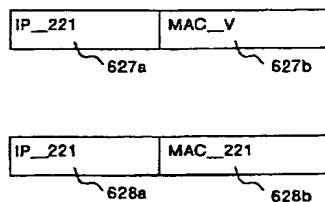
【図18】



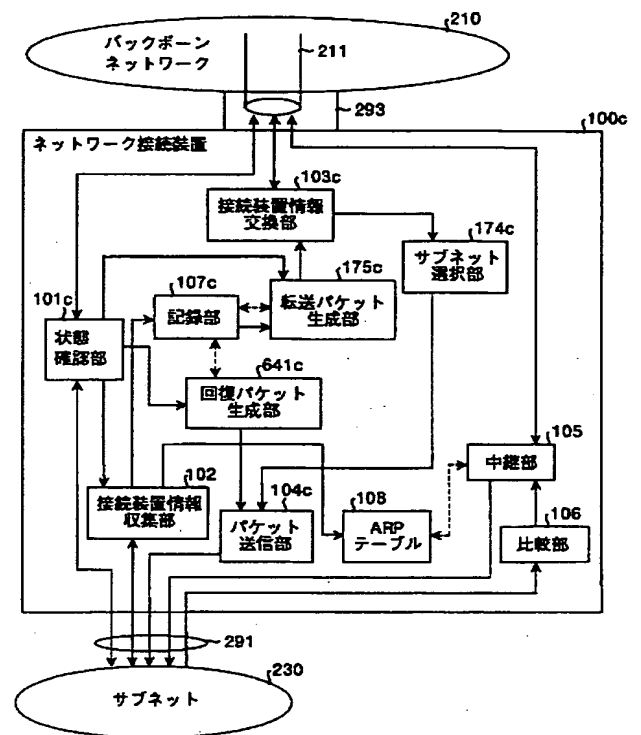
【図21】



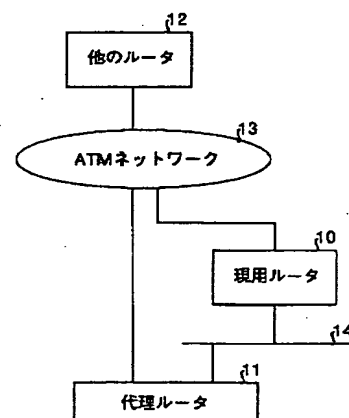
【図22】



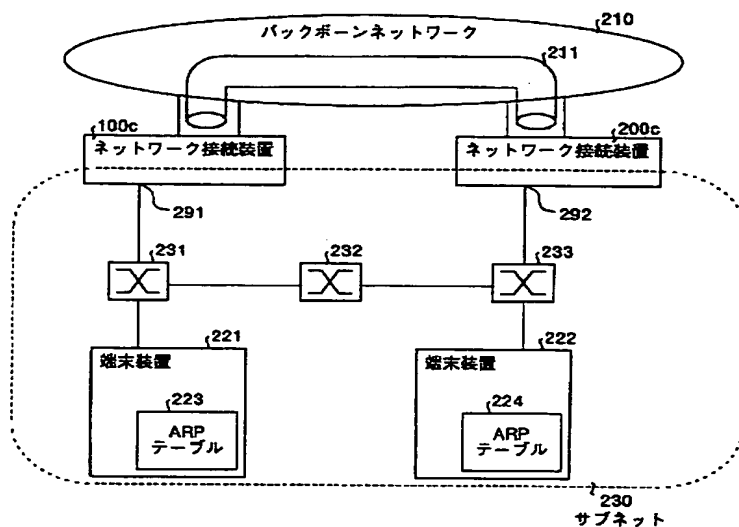
【図19】



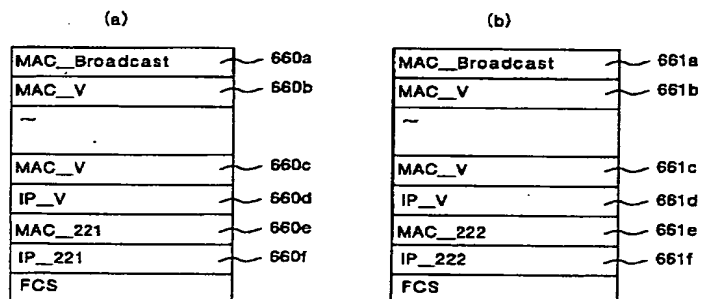
【図28】



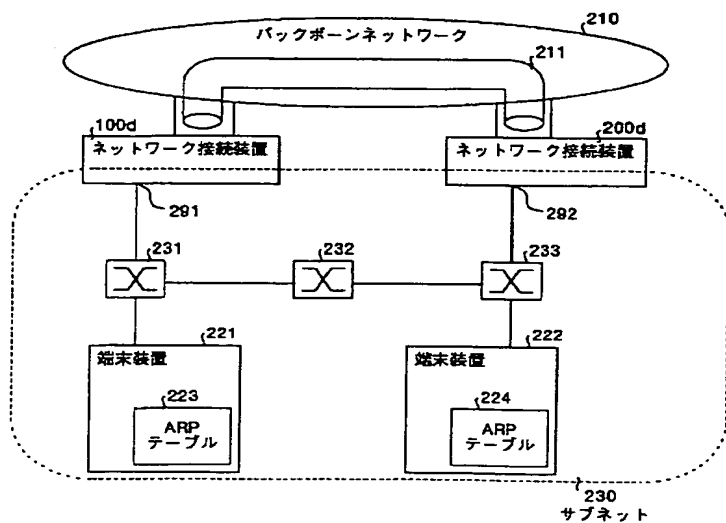
【図20】



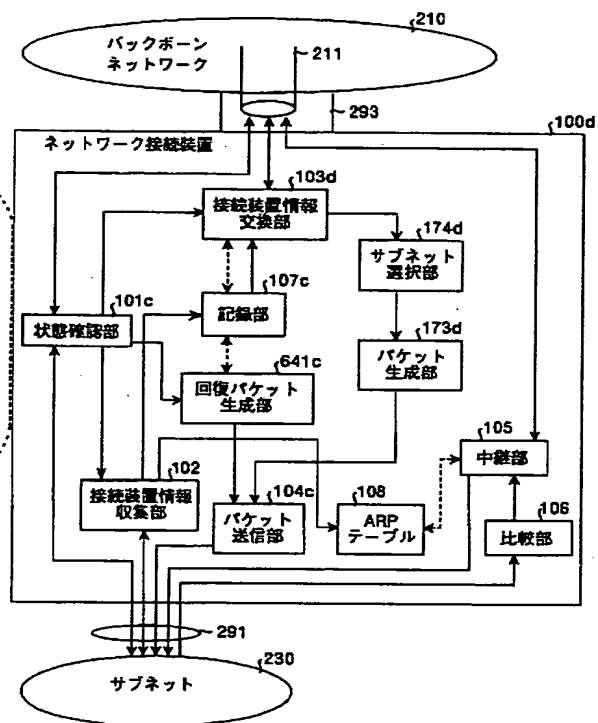
【図25】



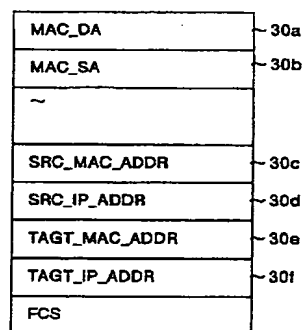
【図27】



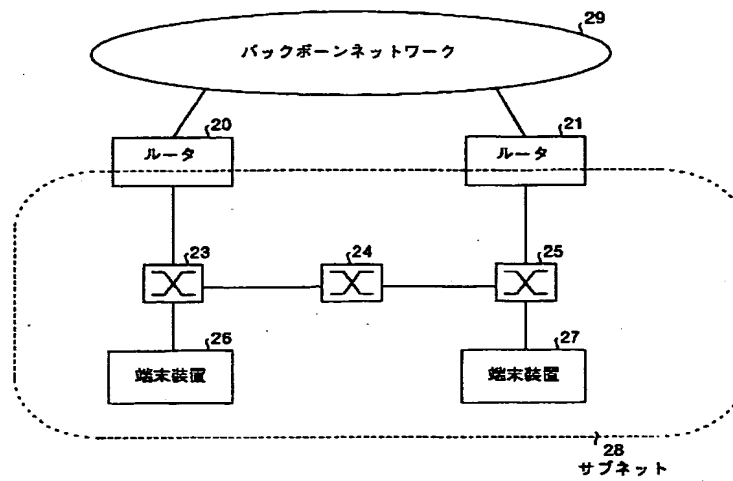
【図26】



【図30】



【図29】



フロントページの続き

(72)発明者 市橋 立機
東京都千代田区丸の内二丁目2番3号 三
菱電機株式会社内

Fターム(参考) 5K030 GA12 HA08 HA10 HC20 HD01
HD06 HD10 LB08 MB01
5K033 AA06 BA08 DA05 EA04 EC04